NAUGATUCK RIVER BASIN
TORRINGTON, CONNECTICUT

REUBEN HART RESERVOIR DAM

CT 00096

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

1979

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Reuben Hart Reservoir

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

Reuben Hart Reservoir Dam is an earth embankment about 1,000 ft. long, 15 ft. wide at the crest, with a maximum height of about 50 ft. The dam is operated by Torrington Water Company as a water supply facility for the City of Torrington. Reuben Hart Reservoir covers about 130 acres and has a maximum storage capacity of about 3,100 acre-ft. The drainage area is about 5.1 sq. mi. Based on both height and storage capacity the project is classified as intermediated in size.

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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

REPLY TO
ATTENTION OF

NEDED

APR 20 1979

Honorable Ella T. Grasso
Governor of the State of Connecticut
State Capitol
Hartford, Connecticut 06115

Dear Governor Grasso:

I am forwarding to you a copy of the Reuben Hart Reservoir Dam Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Department of Environmental Protection, the cooperating agency for the State of Connecticut. In addition, a copy of the report has also been furnished the owner, Torrington Water Company, 110 Prospect Street, P.O. Box 867, Torrington, Connecticut 06790, Attn: Mr. Richard Calhun, President.

Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Department of Environmental Protection for your cooperation in carrying out this program.

Sincerely yours,

JOHN P. CHANDLER
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

REUBEN HART RESERVOIR DAM

CT 00096

NAUGATUCK RIVER BASIN
TORRINGTON, CONNECTICUT

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT

Identification No.:	CT 00096
Name of Dam:	Reuben Hart Reservoir Dam
City:	Torrington
County and State:	Litchfield, Connecticut
Stream:	Hart Brook
Date of Inspection:	24 October 1978

BRIEF ASSESSMENT

Reuben Hart Reservoir Dam is an earth embankment about 1,000 ft. long, 15 ft. wide at the crest, with a maximum height of about 50 ft. The dam is operated by Torrington Water Company as a water supply facility for the City of Torrington.

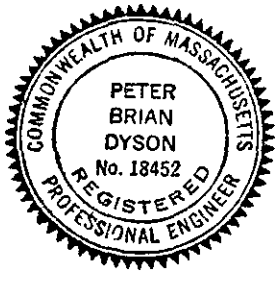
Built in 1933, the original spillway was a concrete ogee overflow 55 ft. long which spilled into Hart Brook. In 1960 a complete revision of the spillway arrangement was undertaken in conjunction with the construction of Hall Meadow Brook Dam, a flood control facility to the east of Reuben Hart Dam. The new service spillway is 125 ft. long and spills into Hall Meadow Brook Reservoir. An auxiliary spillway which spills into Hart Brook has an effective length of about 202 ft. and is 3.5 ft. higher than the service spillway. The outlet works include a wet well shaft with selective level inlets connected to two 18 in. dia. pipes under the dam. Beyond the toe of the dam the two 18 in. pipes join into one 24 in. dia. pipe, which turns 90° about 100 ft. from the toe, where a valve controls discharges through an 18 in. dia. pipe into a small pond on Hart Brook.

Reuben Hart Reservoir covers about 130 acres and has a maximum storage capacity of about 3,100 acre-ft. The drainage area is about 5.1 sq. mi. Based on both height and storage capacity the project is classified as intermediate in size. Because the dam is immediately upstream from several communities and the City of Torrington, which could sustain serious damage in the event of a dam failure, the project has been classified as having a high hazard potential.

The dam appears to be in good condition. The combined service and auxiliary spillways are adequate to pass the full PMF test flood without overtopping the dam. Two wet areas due to seepage were noted downstream from the toe of the dam. Some riprap on the upstream face has been displaced due to ice jacking. The top of the concrete wall between the dam and spillway has disintegrated.

Within two years of receipt of the Phase I Inspection Report, the owner, Torrington Water Company, should retain the services of a competent registered professional engineer and implement the results of his evaluation of the cause of the seepage and wet areas at the toe of the dam. The owner should also implement the following operational and maintenance measures: keep brush growth cut at the downstream toe to facilitate inspection of seepage; monitor seepage periodically during periods of high reservoir level; repair riprap where displaced; repair concrete wall at end of spillway; and develop a formal surveillance and flood warning plan.

Peter B. Dyson
Project Manager



Frederick Esper
Vice President

This Phase I Inspection Report on Reuben Hart Reservoir Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

JOSEPH W. FINEGAN, JR., MEMBER
Water Control Branch
Engineering Division

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

JOSEPH A. MCELROY, CHAIRMAN
Chief, NED Materials Testing Lab.
Foundations & Materials Branch
Engineering Division

APPROVAL RECOMMENDED:

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

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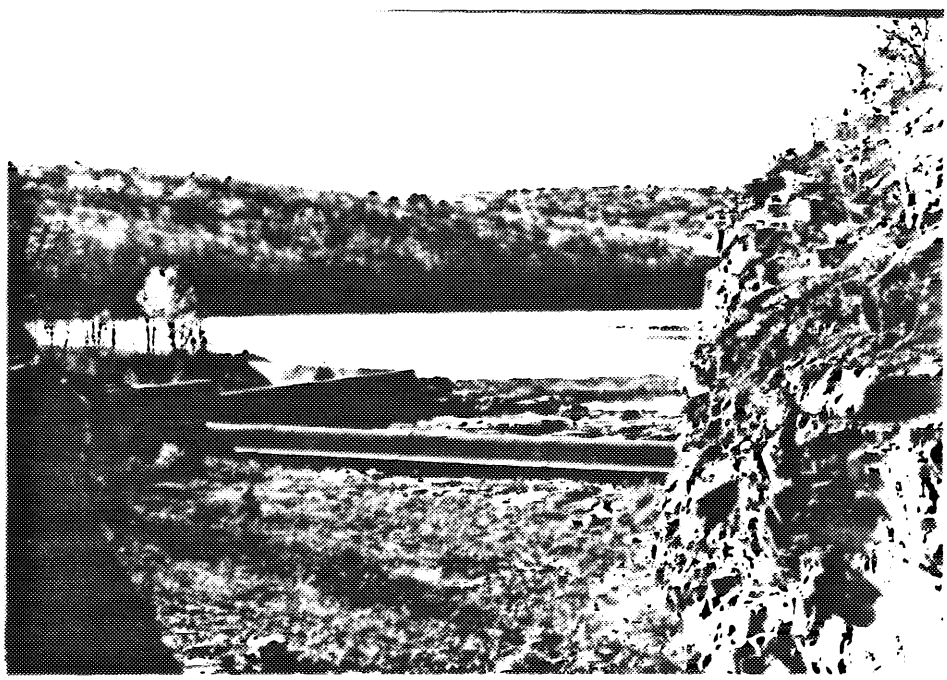
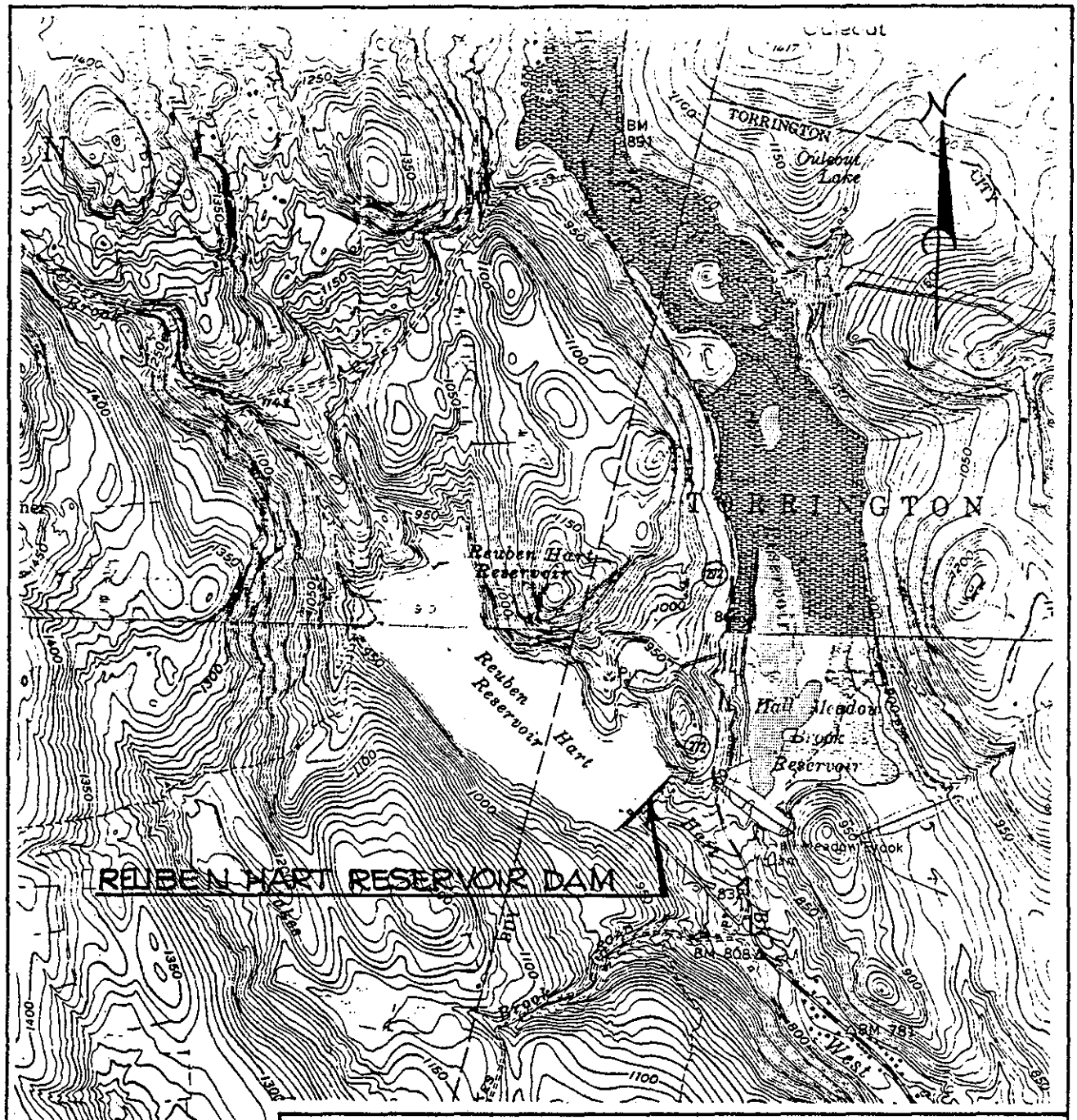
Overview of dam from right abutment.



Overview of spillways from downstream chute.



LOUIS BERGER & ASSOC., INC WELLESLEY, MASS. ARCHITECT · ENGINEER	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

REUBEN HART RESERVOIR DAM

W. TORRINGTON, NORFOLK, CT. QUADRANGLE

NAUGATUCK RIVER BASIN **STATE - CT.**

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PHASE I INSPECTION REPORT

REUBEN HART RESERVOIR DAM CT 00096

SECTION 1 - PROJECT INFORMATION

1.1 General

a. Authority

Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a national program of dam inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Louis Berger & Associates, Inc. has been retained by the New England Division to inspect and report on selected dams in the State of Connecticut. Authorization and notice to proceed was issued to Louis Berger & Associates, Inc. under a letter of 24 August 1978 from Ralph T. Garver, Colonel, Corps of Engineers. Contract No. DACW33-78-C-0371 has been assigned by the Corps of Engineers for this work.

b. Purpose

1. Perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.

2. Encourage and assist the States to initiate quickly effective dam safety programs for non-Federal dams.

3. Update, verify and complete the National Inventory of Dams.

1.2 Description of Project

a. Location

Reuben Hart Dam is located on Hart Brook, immediately above its confluence with Hall Meadow Brook, both of which join to become the headwaters of the west branch of the Naugatuck River in northwestern Connecticut. The dam is about 4.5 mi. northwest of Torrington in Litchfield County. Immediately to the east of Reuben Hart Reservoir is Hall Meadow Brook

Reservoir, which has been constructed recently as a flood control retention project.

The normal storage level in Reuben Hart Reservoir is at elevation 911 MSL. Hart Brook meets Hall Meadow Brook at a distance of about 3,000 ft. from the dam where the elevation is about 780. Hall Meadow Brook empties into Stillwater Pond, a distance of about 1.6 mi. from the dam, which has a normal storage level of 735.

b. Description of Dam and Appurtenances

1. Dam

According to the as-built plan dated July 15, 1932 (Appendix B), Reuben Hart Dam is a rolled homogeneous earth embankment having a crest length of approximately 1,000 ft. The spillway elevation is shown on the plan as 664 which corresponds with 911 MSL on the Hall Meadow Brook Dam plans, indicating that the datum for the original plan was 247 ft. below MSL. The original plan shows the dam crest at an elevation of 670.25, or 917.25 MSL. Measurements made at the time of the inspection near the left abutment adjacent to the spillway indicated that the crest of the dam in that area has a level of about 916.8 MSL.

The dam has a maximum height of 50 ft. as measured from original ground surface and approximately 80 ft. at maximum height as measured from the bottom of a concrete core wall trench excavated below original ground surface. The upstream slope of the embankment is faced with hand-placed rock riprap laid on a 2½ to 1 slope. The downstream slope consists of sod on a 2 to 1 slope. A concrete core wall is located along the centerline of dam with top of the wall at about elevation 915, or 2 ft. below the top of the embankment. The core wall extends within a cutoff trench below original ground surface to contact with bedrock between approximately stations 4 + 00 and 10 + 50 (right spillway wall). Between approximately station 0 + 50 (right abutment) and station 4 + 00, the core wall was carried to hardpan or glacial till because the bedrock apparently dips steeply beneath the right abutment. The core wall has a top width of 2 ft. and ½ in. per ft. upstream and downstream batters. Below a 50 ft. height, the core wall has a constant thickness of 6 ft. (Appendix B, as-built plan).

2. Spillway

The spillway, as originally built, was a 55 ft. long ogee overflow at crest level elevation 911, emptying into a curved converging chute excavated in bedrock along the left abutment downstream from the dam. The chute terminated on the hillside in earth cut about 125 ft. downstream from the toe of the dam and 300 ft. to the left of the river below the dam, after which flows were to cascade down the slope to the river.

Although no records were recovered as to damage incurred by the dam or downstream environs during the August 19, 1955 storm, correspondence indicates that the Reuben Hart spillway was deemed inadequate and that an enlargement was warranted. It is said that the reservoir crested just below the top of the dam.

In 1960 a complete revision of the spillway arrangement was undertaken by the New England Division, Corps of Engineers, whereby a new spillway was built to the left of the original and directed so that its releases flow into Hall Meadow Brook Reservoir. This is a flood control facility constructed at that time on Hall Meadow Brook to the east of Reuben Hart Dam. The new spillway arrangement is shown on Drawing No. HC-1-1619 in Appendix B.

The overflow crest of this new spillway was placed at elevation 911, the same as that of the original design. The crest length of this new spillway is 125 ft. The crest of the original spillway was increased to an effective length of 76 ft. and raised 3.5 ft. to a crest level of 914.5. The centerlines of the original overflow crest and the crest of the new auxilliary spillway were offset so that the new crest is about 163 ft. downstream from the original crest location. The common wall between the original spillway chute and the new spillway inlet channel was built to elevation 914.5 for a length of about 126 ft., and this length together with the lengthened original crest are overtopped whenever the reservoir rises to that level. Discharges from this auxiliary spillway flow into and down the original spillway chute to empty into Hart Brook.

The new spillway was excavated in rock and except for the overflow crest structure and abutments it is not concrete lined. The approach channel bottom is 5 ft. below crest level, is 122.5 ft. wide and about 300 ft. long and is lined with an asphalt covering. The downstream chute width converges from 125 ft. at the overflow crest to 40 ft. in a distance of about 330 ft. and

is excavated on a 0.02 percent grade. State Route No. 272 crosses the channel beyond the end of the convergence at which point the channel enters Hall Meadow Brook reservoir; the bridge deck for this crossing is at the same level as Hall Meadow Brook Dam, elevation 917.

Drawings of the revised spillway layout are shown on Corps of Engineers NED drawings HC-1-1619 to 1623 in Appendix B.

3. Outlets

The outlet control facilities are housed in an outlet tower located near the upstream toe of the dam, reached by a bridge from the crest of the dam. The intake tower is a wet well shaft, with selective level inlet pipes placed through the wall and controlled by slide gates on their downstream ends. Metal screens are provided at the inlet ends to screen out debris. Outlet pipes carried just below natural ground level under the dam lead from the intake tower to a chamber about 100 ft. beyond the downstream toe of the dam where a control valve is housed. Two 18 in. dia. pipes are carried under the dam and then join into one 24 in. dia. pipe continuing to the valve chamber. The outlet pipe turns 90 degrees at the chamber and reduces to 18 in. dia., the size of the control valve. The 18 in. dia. pipe is continued to an outlet headwall structure, where flow then spills into a small pond downstream from the dam.

A 6 in. dia. waste pipe is carried from the intake tower well parallel to the outlet pipes, and empties into the 18 in. dia. outfall pipe beyond the control valve.

The intake tower and outlet pipes are located about 300 ft. to the left of the right end of the dam at about elevation 890, or about 27 ft. below the top of the dam and 23 ft. above the river level below the dam. The drawings show the outlet pipes all bedded on concrete cradles.

A low level outlet pipe, 24 in. dia., is located at about the center length of the dam near the position of the original river and at about river level, elevation 867. This pipe was undoubtedly used for river diversion during construction. A headwall structure is indicated to head the pipe at the upstream toe of the dam, but no control gate has been provided. A 24 in. dia. valve is installed near the end of the pipe in a sump at about the downstream toe of the dam. The pipe then empties into a short outlet flume which empties near river level about 35 ft. beyond the toe of the dam.

Size Classification

The Reuben Hart Dam is about 50 ft. high above downstream river level, impounding a maximum storage of about 2,300 acre-ft. to spillway crest level and about 3,100 acre-ft. to top of dam. In accordance with the size and capacity criteria given in Recommended Guidelines for Safety Inspection of Dams, the project falls into the intermediate category for both criteria and is therefore classified accordingly.

d. Hazard Classification

A breach failure of Reuben Hart Dam would release water down Hart Brook and thence into the West Branch of the Naugatuck River, which flows through the City of Torrington. During the August 1955 storm, flood flows in the Naugatuck caused serious damage and it may be expected that any large flood flows would cause damage to communities such as Drakeville and Wrightville in the future. It is therefore concluded that a sudden breach of the dam would cause some loss of life and extensive economic loss. Consequently, Reuben Hart Dam has been classified as having a high hazard potential in accordance with the Recommended Guidelines for the Safety Inspection of Dams.

e. Ownership

The Reuben Hart Reservoir Dam is owned by Torrington Water Company.

f. Operator

Mr. Richard Calhoun,
President,
Torrington Water Company,
110 Prospect Street
P. O. Box 867
Torrington, Connecticut 06790

telephone: (203) 489-4149

g. Purpose of Dam

The Reuben Hart Reservoir is operated as a water supply facility for the City of Torrington.

h. Design and Construction History

The dam was built around 1933 by O & G Industries and Torrington Building Company. It was designed by William G. Smith, a private consultant retained by the Torrington Water Company.

According to water company officials, no repairs were made to the dam until 1960 when a new spillway channel was built in conjunction with the construction of Hall Meadow Brook Dam. Torrington Water Company maintains the new spillway channel up to the State Route 272 bridge.

During the flood of August 19, 1955, the original spillway was considered to be inadequate. While the dam has never been overtopped, the '55 flood crested just below the top of the dam.

Appendix B includes an as-built plan of the original dam and the Corps of Engineers NED drawings for the new spillway facilities constructed in conjunction with Hall Meadow Brook Dam.

i. Normal Operating Procedure

There are no written operating procedures. Water Company personnel are on duty around the clock and are equipped with two-way radios. The water elevation is checked daily. The reservoir is usually full from January to April and lowest at the end of the summer.

1.3 Pertinent Data

a. Drainage Area

The drainage area contributing to the Reuben Hart reservoir is mainly that of Hart Brook and its tributaries, from its headwaters to about ½ mile upstream from the confluence of Hart and Hall Meadow Brooks, which are tributaries of the West Branch of the Naugatuck River. The area measures about 4.5 miles long and averages a little over a mile wide, encompassing a total of 5.07 sq. mi. The area has a relief of about 200 ft. and is heavily forested. North Pond Dam is situated 3.8 mi. upstream from Reuben Hart Dam, at the headwater of Hart Brook, such that 0.94 sq. mi. of the drainage area drains into North Pond reservoir. North Pond reservoir is at a normal level of 1,464; Reuben Hart reservoir is at a normal level of 911. The surface areas of North Pond and Reuben Hart reservoirs comprise about 10 percent of the total drainage area. Hart Brook in this drainage reach has a length of 4.8 mi. and an average slope of about 154 ft. per mi.

b. Discharge at Damsite

Discharge of stored waters at Reuben Hart dam is provided through an 18 in. dia. outlet pipe, which is capable of releasing up to about 45 cfs with reservoir at normal storage

level, elevation 911. For more rapid reservoir evacuation, a low level outlet pipe which served for stream diversion during construction could also be opened, to release up to about 85 cfs at normal reservoir level. The low level pipe is said not to have been opened since construction was completed. Capacity curves are shown on Figure 1, Appendix D, Sheet D-1.

The maximum flood which has been experienced since the dam was built occurred in August 1955, when it was reported that the reservoir surcharge filled to the top of the dam. At that time the spillway crest measured 55 ft., which would indicate a spillway outflow of about 2,900 cfs. The maximum inflow rate is not known.

With the modifications to the spillway which were made in 1960, the spillway capacity was considerably increased. With head to top of dam, the computed service spillway release into Hall Meadow Brook reservoir is about 7,000 cfs; the discharge over the auxiliary crests into the original spillway channel is about 2,300 cfs. Spillway capacity curves are shown on Figure 2, Sheet D-3.

c. Elevation (ft. above MSL)

1.	Top of dam	916.83
2.	Maximum pool-design surcharge	914.5
3.	Spillway crest	911.0
4.	Diversion pipe invert	867
5.	Streambed at centerline of dam	867

d. Reservoir

1.	Length of pool at top of dam	4,600 ft.
2.	Length of pool at normal storage	4,500 ft.
3.	Average width of pool	1,250 ft.

e. Storage (acre-feet)

1.	At normal storage pool	2,300
2.	At design surcharge (el. 914.5)	2,760
3.	At top of dam	3,100

f. Reservoir surface (acres)

1.	Top of dam	141
2.	At design surcharge pool (el. 914.5)	135
3.	Spillway crest	130

g. Dam

1. Type - Homogeneous earth fill embankment
2. Length 1,000 ft.
3. Height 50 ft.
4. Top width 15 ft.
5. Side Slopes - 2½ to 1 upstream; 2 to 1 downstream
6. Zoning - Concrete core wall, homogeneous fill
7. Cutoff - Concrete core wall to bedrock or hardpan. Core wall carried to 2 feet below top of dam.
8. Grout Curtain - none

h. Service Spillway

1. Type - unlined channel
2. Length of Weir 125 ft.
3. Crest Elevation 911 MSL
4. Ungated
5. Upstream Channel - 300 ft. long, 5 ft. below crest level, excavated in rock, floor lined with asphalt covering.
6. Downstream Channel - excavated in rock, unlined converging from 125 ft. width to 40 ft. width.
7. General - Spillway chute directed into Hall Meadow Brook Reservoir.

i. Auxiliary Spillway

1. Type - unlined channel
2. Length of Weir 202 ft.
3. Crest Elevation 914.5
4. Ungated
5. Upstream Channel - short approach channel 5 to 8 ft. below crest level, unlined.
6. Downstream Channel - curved unlined channel excavated in rock below crest, in earth as it traverses down hill to Hart Brook.
7. General - Spillway chute directed into Hart Brook below dam.

j. Regulating Outlets

1. Invert Elevation 889 MSL
2. Size - Two 18 in. dia. pipes joining 1-24 in. pipe, converging to 18 in. valve and 18 in. outlet.
3. Control Mechanism - 2-18 in. slide gates at inlets; 1 18 in. gate valve near outlet.

SECTION 2 - ENGINEERING DATA

2.1 Design

The dam was designed by William G. Smith, a consultant retained by the Torrington Water Company. During the storm of August 19, 1955, the reservoir crested just below the top of the dam and the original spillway was deemed to be inadequate. A new spillway arrangement was designed by the Corps of Engineers NED in 1960, in conjunction with the design of the adjoining Hall Meadow Brook Dam, known as Reuben Hart Diversion. A new spillway was provided at the same elevation as the original, but spilling via a new channel behind the new flood control dam on Hall Meadow Brook. The crest of the old spillway was raised 3.5 ft. and incorporated into a new auxilliary spillway, which would spill into the original channel.

2.2 Construction

The dam was built about 1933 by O & G Industries and Torrington Building Company, Torrington. According to Water Company officials, no repairs were made to the dam during the next 27 years. In 1960 the new spillway channel and spillways were built in conjunction with the construction of Hall Meadow Brook Dam.

2.3 Operation

The dam is operated by the Torrington Water Company as part of the municipal water supply system for the City of Torrington. There appear to be no formal records other than reservoir levels.

2.4 Evaluation

a. Availability

The original plan and drawings of the reconstructed spillways, plus the visual observations of the inspection team, form the basis for the information presented in this report.

b. Adequacy

The lack of in-depth data, such as shear strengths of the embankment materials, precludes a definitive review and assessment of this dam. The evaluation is based primarily on visual inspection and engineering judgment, while taking into account the past performance of the dam.

c. Validity

The validity of the engineering data acquired covering the dam and spillways is considered acceptable and is not challenged.

SECTION 3 - VISUAL INSPECTION

3.1 Findings

a. General

The visual inspection of Reuben Hart Reservoir Dam took place on 24 October 1978. The dam is judged to be in a generally good condition. There is some seepage at the downstream toe of the embankment. The spillways were constructed in 1960 and the concrete surfaces are in good condition. There was no evidence of any major maintenance problems.

b. Dam

The horizontal and vertical alignment of the dam embankment is good (Overview Photo, p. viii). The upstream slope consists of hand placed riprap, which is in generally good condition (Appendix C, Photo No. 1). At approximately Sta. 5+40 (Plan, Appendix B) about 6 ft. below the crest of the dam, the riprap has been moved by ice jacking and the grass slope above it has moved downwards slightly. Left of the gatehouse structure the upstream edge of the crest of the dam appears to have settled about 6 in. for a distance of 200 to 300 ft. It may be that this apparent settlement has either been caused by ice jacking of the riprap slope or by differential settlement within the embankment structure. This appears to be a shallow phenomenon and of no major consequence.

The downstream slope shows no bulges, sags or other evidence of movement, is well maintained and regularly mowed, and generally appears to be in good condition (Appendix C, Photo No. 2). The downstream toe is wet for a distance of about 150 ft. to the left of the 24 in. dia. outlet and valve chamber, but there are no well-defined seepage points or boils. About 80 ft. to the right of the valve chamber there is another wet area extending for about 15 ft. along the toe and 50 ft. downstream normal to the axis of the dam. This area seems to be lower than the general terrain and it may collect some runoff from the slopes forming the right abutment, in addition to seepage from the dam. Farther downstream from this point there is a natural drainage swale which appears to be picking up seepage from the dam, in addition to runoff from the high ground downstream from the right abutment. A small volume of water is also seeping out of the end of the

24 in. dia. pipe, perhaps of the order of 1 to 2 gpm.

There is some brush growth along the downstream toe for a distance of about 150 ft. left of the 24 in. dia. pipe. To some extent this brush interfered with close observation of the wet area and it should be cleared before future inspections.

The flows from the various areas of seepage converge at a point about 150 ft. downstream of the toe of the dam and about 80 ft. right of the 24 in. dia. pipe outlet. It appears that this point is part of the old channel of Hart Brook. The total volume of visible seepage is about 20 to 30 gpm, is clear and clean, and does not appear to be carrying any fines.

c. Appurtenant Structures

1. Spillways

The approach and discharge channels at the main spillway are excavated in bedrock. The rock slopes appear to be stable, with no loose blocks or insipient slides evident. The concrete in the overflow crests is sound, with little evidence of cracks (Appendix C, Photo No. 3). The single exception is the old retaining wall between the spillway and dam, where up to 10 in. of the top of the wall has disintegrated. This concrete wall should be capped to prevent further deterioration.

The present auxiliary spillway channel was originally the main spillway channel when the dam was first built. At the weir this channel is also in bedrock, but some distance below the weir it was excavated in earth and riprapped. The riprap has evidently not been maintained recently. The auxiliary spillway weir is in good condition (Appendix C, Photo No. 5).

2. Outlet Structure

The intake tower is a concrete wet well shaft with three selective level inlet pipes controlled by slide gates (Appendix C, Photo No. 6). Two 18 in. dia. outlet pipes and a 6 in. dia. waste pipe are connected to the tower at approximately original ground level. A brick gatehouse contains the manual gate controls and is connected to the crest of the dam by a bridge. The concrete is in fair condition with some minor cracks and spalling noted. A portion of the roofing requires repair. The gates were not operated during the inspection, but according to Water Company staff all of them are serviceable.

The 24 in. dia. low level outlet pipe has a control valve in a sump near the downstream toe of the dam. This valve was not operated and it is not known whether it is serviceable. It is said not to have been operated since construction of the dam in 1933.

d. Reservoir Area

An inspection of the reservoir shoreline revealed no evidence of slides or sloughing into the reservoir. The reservoir is in a restricted water supply preserve and no habitations are permitted along the shoreline.

e. Downstream Channel

The downstream channel converges from a width of 125 ft. at the main spillway crest to 40 ft. in a distance of about 330 ft. There is some light brush growth in the channel which should not be allowed to become established (Appendix C, Photo No. 4).

Hart Brook and the West Branch of the Naugatuck River continue downstream from Reuben Hart Dam in a narrow valley for 1 mile to the Town of Drakeville. The River then empties into Stillwater Pond, a 1½ mi. long reservoir with a surface area of 95 acres. The Hall Meadow Brook, which joins Hart Brook about ½ mi. below Reuben Hart Dam, has been diked off by the construction of the right portion of Hall Meadow Brook Dam. The spillway for that dam has been directed to a lower tributary which joins the Naugatuck River below Drakeville. Service spillway releases from Reuben Hart reservoir spilling into Hall Meadow Brook reservoir would thus not traverse Hart Brook above Drakeville, but auxiliary spillway releases would spill into the Hart Brook Valley.

If a breach failure of Reuben Hart Dam were to occur, Hart Brook Valley below the dam would be flooded. There are more than 10 homes along the valley to Drakeville that appear to be well within the flood plain of Hart Brook above Drakeville, and a trailer park is situated in the flood plain in Drakeville.

The West Branch of the Naugatuck River downstream from Stillwater Pond continues in a relatively narrow valley to the City of Torrington, and then traverses through the City in a broad flood plain. There appear to be more than 20 homes within the flood plain from Stillwater Pond to the City, and many homes and industrial buildings would undoubtedly be affected by high water in Torrington itself.

3.2 Evaluation

The visual inspection of the dam revealed sufficient information to permit an assessment of those features affecting the safety and stability of the structure to be made. The dam and appurtenant works are judged to be in good condition.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 Procedures

The Reuben Hart Reservoir Dam is operated by personnel of the Torrington Water Company. Reservoir operation entails mainly the release of stored water from the reservoir as water supply needs warrant. No documented operating procedures have been prepared.

4.2 Maintenance of Dam

Little maintenance is required except for the periodic cutting of brush and other growth on the dam embankment. No documented maintenance instructions have been prepared, but routine maintenance appears to be regularly carried out.

4.3 Maintenance of Operating Facilities

The slide gate and gate valve operating mechanisms in the outlet structure require periodic maintenance to keep them serviceable, and appear to be inspected regularly. The low-level 24 in. dia. outlet valve is not used and has not been maintained.

4.4 Warning System

There is no formal warning system or program at this dam. A program should be evolved, with sequences and responsibilities for emergency situations defined and personnel trained in its implementation.

4.5 Evaluation

This dam has simple operating devices and as such, requires no detailed operating procedures. Outlet operating valves require checking for serviceability. Maintenance involves periodic growth removal from the dam and surveillance regarding seeps, slope damage, animal burrows, etc. Inspection observations noted that the facility appears to be generally well maintained. A formal warning and emergency evacuation system should be developed.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. Design Data

1. Hydrology - General

Since significant storage is provided by the North Pond Reservoir, which drains and occupies the upper portion of the drainage area above Reuben Hart Dam, separate runoff hydrographs were developed for each sub-basin. The inflow above the North Pond Dam was routed through that reservoir, and then combined with the runoff hydrograph for the lower sub-basin to provide an inflow hydrograph for routing through the Reuben Hart Reservoir and spillways.

2. Drainage Areas

The drainage area of Hart Brook above Reuben Hart Dam is about 5.07 sq. mi., of which about 0.94 sq. mi. lies above North Pond Dam. North Pond Reservoir is about 1 mi. in length, extending from the very headwater of Hart Brook. The Brook traverses about 2.9 mi. downstream from North Pond Dam to Reuben Hart Reservoir, at an average slope of about 154 ft. per mile. Reuben Hart Reservoir extends upstream about 0.93 miles from Reuben Hart Dam.

3. Reservoir Areas and Capacities

For determining reservoir surface areas and surcharge capacities of North Pond and Reuben Hart Reservoirs, planimetered areas were taken from contours delineated on the USGS 2,000 ft. per in. quadrangle sheets. The North Pond Reservoir has an area at normal storage of about 195 acres; Reuben Hart Reservoir has an area of about 130 acres. Area-capacity tables showing surcharge storage in both reservoirs, for use in flood routings, are shown on Sheet D-7 of Appendix D.

4. Flood Hydrology

Reuben Hart Dam is 50 feet high and impounds about 3,100 acre-feet of storage to top of dam; as noted in Section 1.2c it is therefore categorized in the intermediate

classification. As noted in Section 1.2d, the hazard potential is classified as high. The Recommended Guidelines for Safety Inspection of Dams require that for hydraulic evaluation the dam adequacy be tested for a flood of full PMF.

Precipitation data were obtained from Hydrometeorological Report No. 33, which for the Connecticut area approximates 24.3 in. of point rainfall over a 10 square mile drainage area. This value was reduced by 20 percent to allow for basin size, shape and fit factors. The 6-hour rainfall duration curve of 19.2 in. was then distributed and rearranged as suggested in Design of Small Dams, from which inflow hydrographs were prepared (see Sheet D-8, Appendix D). For the lower sub-area a constant infiltration loss of 0.1 in. per hour was deducted from the precipitation values to give the excess rainfall amounts used to prepare the hydrograph.

For the upper sub-area, because of the small drainage area compared with the surface area of the reservoir (3 to 1 ratio), and because of the steep slopes adjacent to the reservoir, no lag time was assumed and instantaneous runoff was taken from direct precipitation on the area (see Sheet D-9, Appendix D). For the lower sub-basin draining into Reuben Hart Reservoir, a lag time of about 3.7 hours was assumed for preparing a unitgraph, on the basis of an average velocity of about 1 ft. per sec.
tration. A curvilinear adaptation of the triangular unitgraph was utilized, shaped as described in Design of Small Dams (see Sheet D-10 in Appendix D).

Routing the PMP direct runoff from the sub-drainage area above North Pond Dam through the North Pond Reservoir and spillway results in a peak outflow of 1,695 cfs, with surcharge storage rising to about 1 ft. below the top of that dam (see computer printout graph, Figure 4, Sheet D-11 in Appendix D). The hydrograph for the lower sub-basin indicates a peak flow of 8,048 cfs occurring at the 6th hour of the flood event. This corresponds to a value of about 1,950 cfs per sq. mile.

The outflow from North Pond Reservoir was then combined with the runoff hydrograph from the lower sub-basin, assuming a 1½ hour transport time for the North Pond outflow to traverse the stream to Reuben Hart Pond. The combined hydrographs indicate a peak inflow of about 9,800 cfs, occurring about 6½ hours after the start of the flood event.

Routing the combined inflow hydrograph through the Reuben Hart Reservoir and spillways results in a maximum surcharge to elevation 916.85, or about to the top of the dam. The service spillway outflow into Hall Meadow Brook Reservoir would approximate 6,900 cfs and the auxiliary spillway outflow into Hart Brook would be about 2,400 cfs. A flood routing for this PMF event is shown on Figure 5, Sheet D-12, Appendix D. Calculations for computer inputs and computer printouts for the development of the hydrographs and flood routings by the HEC-1 program are exhibited in Appendix D.

A ½ PMF event was also routed through the reservoir and spillways, resulting in a maximum surcharge to elevation 915.15. The discharge through the service spillway for this head approximates 4,000 cfs. Flow over the auxiliary spillway would be at a 0.65 ft. head, with a release of about 300 cfs.

b. Experience data

Except for the flood of August 1955, when it is said that the surcharge at Reuben Hart Reservoir filled to the top of the dam, no records are available regarding past operation of the reservoir or surcharge encroachments and spills through the spillway. The spill in 1955 through the old 55 ft. crest spillway is computed to be about 2,900 cfs. The maximum inflow rate is not known.

c. Visual Observations

From a cursory examination for scouring in the original spillway chute, there was no evidence that the auxiliary spillway has operated since it was built. It is not known whether spills have been released through the service spillway since it was constructed in 1960.

d. Overtopping Potential

As noted in Section 5.1a, the maximum surcharge head resulting from a routing of a PMF would reach just to the top of the dam. The threat of a breaching of the dam from overtopping would therefore not materialize.

e. Drawdown Capacity

Drawdown of the reservoir is possible by opening the outlets, and in an emergency, by also opening the low level outlet valve. For evacuating the reservoir to the sill of the intake tower inlet, an average release of about 100 cfs would be

possible. For the 1,860 acre-feet of storage between the outlet sill and the spillway crest, a period of about 9 days would be required to release the storage, assuming no inflow in the interim. An additional 4.5 days would be needed to empty the reservoir to the inlet of the low level outlet.

f. Downstream Hazard

In the event of a dam failure from causes other than overtopping, it may be assumed that a breach could occur with a bottom width of 20 ft. at the level of the bottom of the dam, and with slopes at about 1.4 to 1 (angles of repose). Such a breach would suddenly release a flood wave of about 40,000 cfs downstream. This flow would diminish rapidly as the reservoir emptied. Figure 6, Sheet D-13, Appendix D shows storage and discharge versus time for such a breach emptying.

It should be noted that the dam has a concrete core wall extending from foundation to within 2 ft. of the top of dam. If piping or sloughing developed in the dam, it is expected that the washout would be gradual and it is unlikely that a sudden breach such as is demonstrated above would develop from this cause.

As noted in Section 1.2d and Section 3.1e, large outflows from Reuben Hart Reservoir owing to near maximum flood inflows or to a breach in the dam would cause great damage downstream to and through the City of Torrington. Stage-discharge curves for two selected points on the West Branch of the Naugatuck River below Reuben Hart Dam were computed to indicate the flow depths in the event of large outflows from the Reuben Hart and Hall Meadow Brook Reservoirs, or from a breach in Reuben Hart Dam. These curves are shown on Figure 7, Sheet D-15, Appendix D. For a 35,000 cfs outflow the stage at Drakeville, about 1¼ miles below Reuben Hart Dam, would be about 15 feet. For the same outflow the stage at West Torrington, about 3 3/4 miles downstream, would be about 20 feet. Delineated on the USGS quadrangle sheet (Figure 8, Sheet D-17, Appendix D) is the approximate extent of the river valley which will be inundated. It can be seen that many homes and commercial establishments near Drakeville, Wrightville and West Torrington would be inundated at this river stage.

SECTION 6 - STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

The field investigations of the earth embankment revealed no significant displacements or distress which would warrant the preparation of slope stability computations based on assumed soil properties and engineering factors. Data on the engineering characteristics of the embankment material is lacking.

b. Design and Construction Data

No plans or calculations of value to a stability assessment are available for this dam.

c. Operating Records

There are no formal operating records for this dam. The reservoir level is recorded daily.

d. Post Construction Changes

The results of the field inspection and a check of the available records produced no evidence of post construction changes which might influence stability of the embankment. Modifications to the spillway have enhanced hydraulic capacity as discussed elsewhere in this report.

e. Seismic Stability

The dam is located in Seismic Zone No. 1 and, in accordance with recommended Phase I guidelines, does not warrant seismic analyses.

SECTION 7 - ASSESSMENT, RECOMMENDATIONS & REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition

On the basis of the Phase I visual examination, Reuben Hart Reservoir Dam appears to be in good condition and functioning adequately. The deficiencies revealed are not of major concern, but tend to indicate that a small amount of additional routine maintenance is required.

There are two wet areas due to seepage below the downstream toe of the embankment. Some riprap on the upstream slope has been displaced by ice jacking. Although the downstream slope is mowed regularly, there is some minor brush on portions of the toe area which impedes inspection of seepage areas.

The spillway capacity is adequate to pass the test flood without overtopping the dam. Being of relatively recent design and construction (1960) both the service and auxiliary spillways are in good condition. The top of the concrete retaining wall between the spillway and embankment has disintegrated.

b. Adequacy of Information

The information recovered is considered adequate for the purpose of making an assessment of the performance of the dam.

c. Urgency

The recommendations and remedial measures enumerated below should be implemented by the owner within two years after receipt of the Phase I Inspection Report.

d. Need for Additional Investigation

Additional investigations are required as recommended in Para. 7.2.

7.2 Recommendations

It is recommended that the owner should retain the services of a competent registered professional engineer to make investigations, studies, and, if proved necessary, to design remedial works to rectify the seepage and wet areas downstream of the toe of the dam.

7.3 Remedial Measures

a. Operation and Maintenance Procedures

1. Brush growth at the toe of the downstream slope between Sta. 6+80 and Sta. 8+50 (Plan, Appendix B) should be removed. The downstream toe should be kept visible for future inspections.

2. The disintegrated concrete at the top of the wall between the service spillway and dam should be repaired.

3. The displaced riprap near the top of the upstream slope between Sta. 4+00 and Sta. 7+00 should be repaired or realigned.

4. Procedures should be instituted for a biennial periodic technical inspection of the dam and appurtenant works, with supplementary inspections of any suspect items.

5. Wet areas along the toe of the downstream slope should be monitored for quantity and clarity during periods of high reservoir level, and at least once a year.

6. A formal flood surveillance, warning and emergency evacuation plan should be developed, and an operational procedure to be followed in the event of an emergency should be adopted.

7.4 Alternatives

There are no appropriate alternatives in the case of Reuben Hart Reservoir Dam.

APPENDIX A

VISUAL INSPECTION CHECKLIST

VISUAL INSPECTION
PHASE I

Identification No. CT 00096 Name of Dam: Reuben Hart Reservoir Dam

Date of Inspection: 24 October 1978

Weather: clear Temperature: 60°F±

Pool Elevation at Time of Inspection: 900.5 MSL

Tailwater Elevation at Time of Inspection: Not applicable.

INSPECTION PERSONNEL

Pasquale E. Corsetti	Louis Berger & Associates, Inc.	Acting Project Manager
Carl J. Hoffman	Louis Berger & Associates, Inc.	Hydraulics, Structures
Thomas C. Chapter	Louis Berger & Associates, Inc.	Hydrology, Soils
William S. Zoino	Goldberg Zoino Dunnicliff & Assoc., Inc.	Soils

OWNER'S REPRESENTATIVE

Richard Calhoun	Torrington Water Company	President
William Jones	Torrington Water Company	Superintendent
John Roberts	Hartford Insurance Company	Agent

VISUAL INSPECTION CHECK LIST

Identification No.: CT 00096 Name of Dam: Reuben Hart Reservoir Sheet 1

VISUAL EXAMINATION OF	OBSERVATIONS AND REMARKS
EMBANKMENT Vertical alignment and movement	Minor 6 in. slumps of crest of U/S slope due to ice jacking of riprap.
Horizontal alignment and movement	No movement evident; alignment good.
Unusual movement or cracking at or near the toe	None evident.
Surface cracks	None evident.
Animal burrows and tree growth	None evident.
Sloughing or erosion of slopes	None evident.
Riprap slope protection	Good condition. Minor slump of U/S slope due to ice jacking Sta. 4+00 to Sta. 7+00.
Seepage	1-2 gpm at 24" dia. low level outlet pipe. 20-30 gpm in old Hart Brook channel d/s of dam.

VISUAL INSPECTION CHECK LIST

Identification No.: CT 00096 Name of Dam: Reuben Hart Reservoir

VISUAL EXAMINATION OF	OBSERVATIONS AND REMARKS
Piping or boils	Wet areas noted below toe of d/s slope.
Junction of embankment and abutment, spillway and dam	No problems evident. Top of concrete wall between spillway and dam has disintegrated.
Foundation drainage	None.
OUTLET WORKS Approach channel	None.
Outlet conduit concrete surfaces	N/A
Intake structure	Concrete tower shows some spalling and minor cracking. Roof shingles missing on right side.
Outlet structure	Concrete headwall in good condition.
Outlet channel	Natural stream channel

VISUAL INSPECTION CHECK LIST

Identification No.: CT 00096 Name of Dam: Reuben Hart Reservoir Sheet 3

VISUAL EXAMINATION OF	OBSERVATIONS AND REMARKS
Drawdown facilities	18 in. dia. control valve on 18 in. dia. outlet pipe. 24 in. dia. control valve on 24 in. dia. low level outlet pipe. Valves said to be operable but not tested.
SPILLWAY STRUCTURES Concrete weir	Main and auxiliary weirs both in good condition.
Approach channel	Cut in rock, condition good.
Discharge channel	Main channel cut in rock, condition good, minor brush growth. Auxiliary channel partly in rock and partly in earth, condition satisfactory.
Stilling basin	None.
Bridge and piers	None.
Control gates and operating machinery	None.

VISUAL INSPECTION CHECK LIST

Identification No.: CT 00096 Name of Dam: Reuben Hart Reservoir

VISUAL EXAMINATION OF	OBSERVATIONS AND REMARKS
INSTRUMENTATION Headwater and tailwater gages	None.
Embankment instrumentation	None.
Other instrumentation	None.
RESERVOIR Shoreline	Rocky shoreline; gently sloping; wooded; appear stable.
Sedimentation	None observed.
Upstream hazard areas in event of backflooding	None noted.
Alterations to watershed affecting runoff	None noted.
DOWNSTREAM CHANNEL Constraints on operation of dam	Discharge channel reduces from 122 ft. to 45 ft. beyond Route 272 bridge.

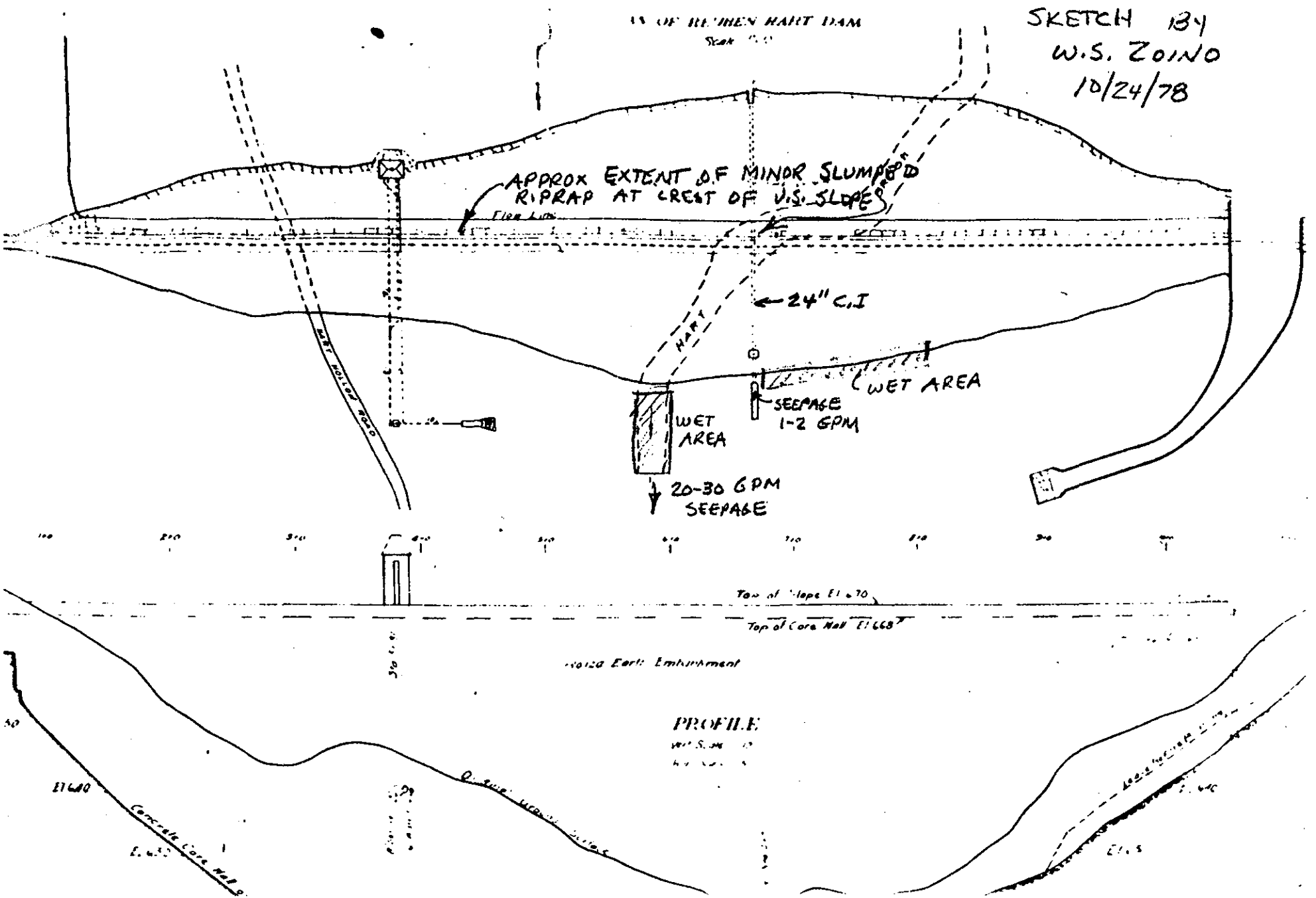
VISUAL INSPECTION CHECK LIST

Identification No.: CT 00096 Name of Dam: Reuben Hart Reservoir Sheet 5

VISUAL EXAMINATION OF	OBSERVATIONS AND REMARKS
Valley Section	Main spillway discharges into Hall Meadow Brook Reservoir. Auxiliary spillway discharges into 150' - 200' wide valley
Slopes	Fairly steep.
Approximate No. of homes/population	30± homes between dam and Stillwater Pond; 100± homes between Stillwater Pond and West Torrington; then densely developed City of Torrington.
OPERATION & MAINTENANCE FEATURES Reservoir regulation plan, normal conditions	No formal plan. Water released as required. Reservoir level checked daily.
Reservoir regulation plan, emergency conditions	None.
Maintenance features	Brush cut, crest and downstream slope mowed periodically.

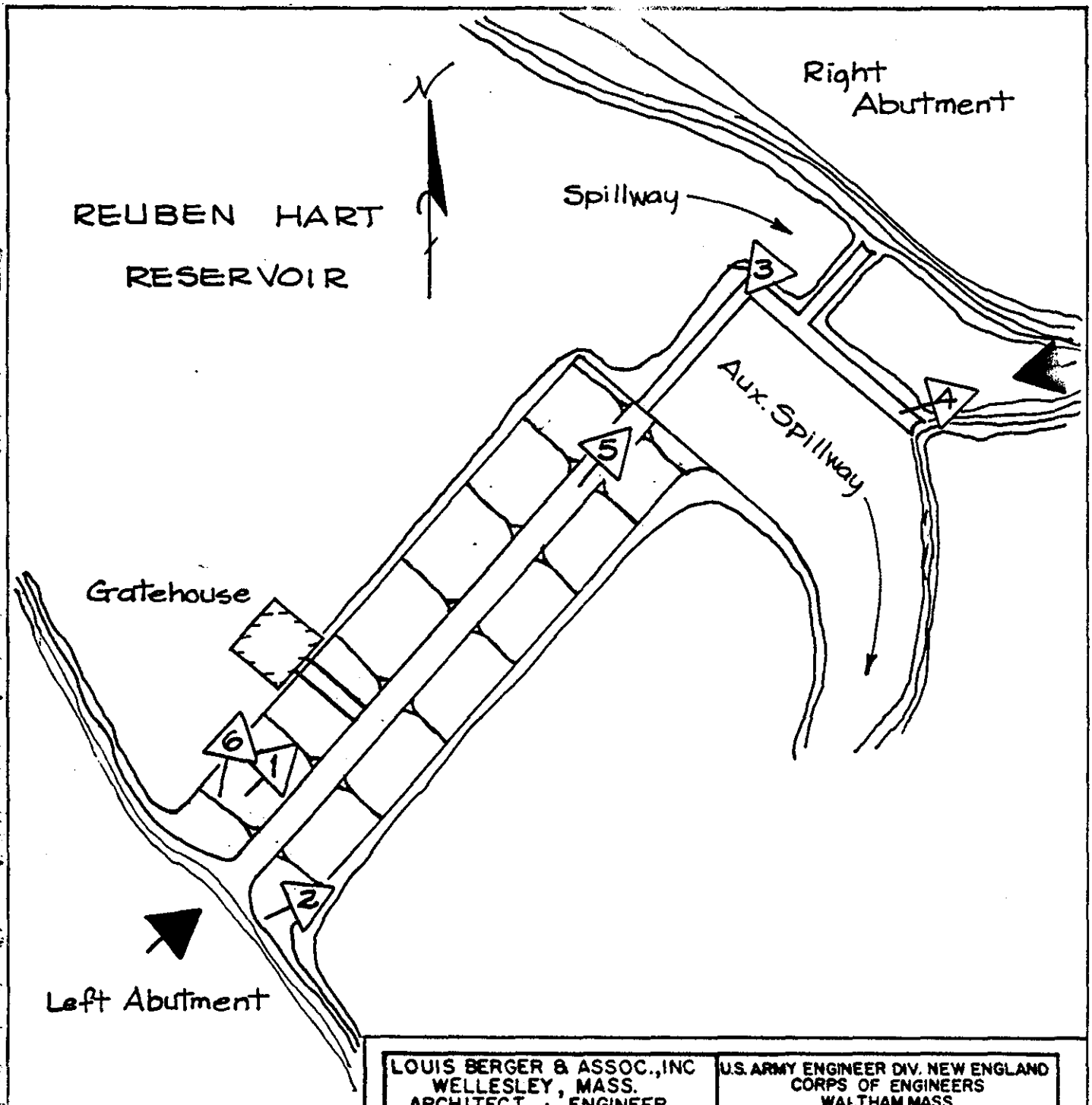
APPENDIX B

PLANS, RECORDS & PAST INSPECTION REPORTS


SKETCH 134
W.S. ZOINO
10/24/78
APPROX EXTENT OF MINOR SLUMPED RIPRAP AT CREST OF U.S. SLOPES
24" C.I
WET AREA
SEEPAGE 1-2 GPM
WET AREA
20-30 GPM SEEPAGE
Top of Slope El 670
Top of Core Wall El 668
PROFILE

APPENDIX C

SELECTED PHOTOGRAPHS



LOUIS BERGER & ASSOC., INC WELLESLEY, MASS. ARCHITECT · ENGINEER	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.

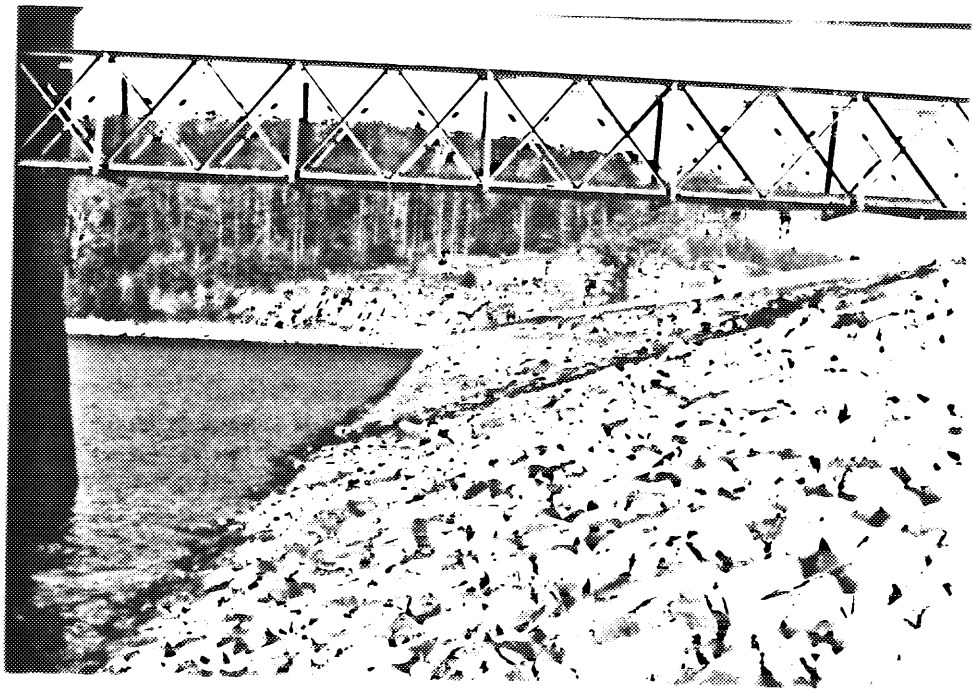
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

REUBEN HART RESERVOIR DAM

SKETCH PLAN SHOWING LOCATION & ORIENTATION OF PHOTOS

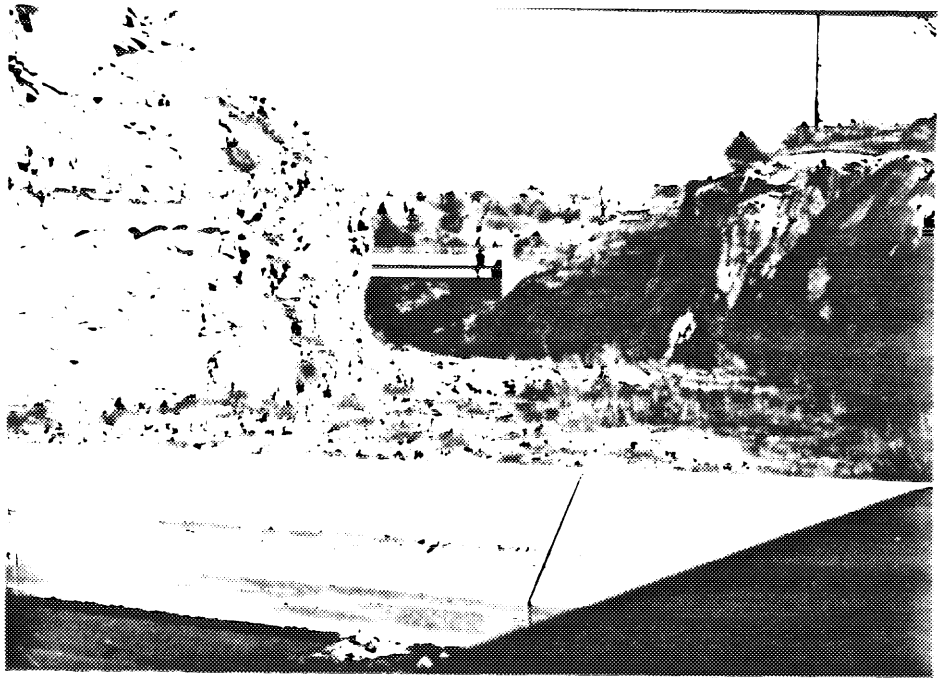
STATE - CT.

			SCALE 1:24000
			DATE

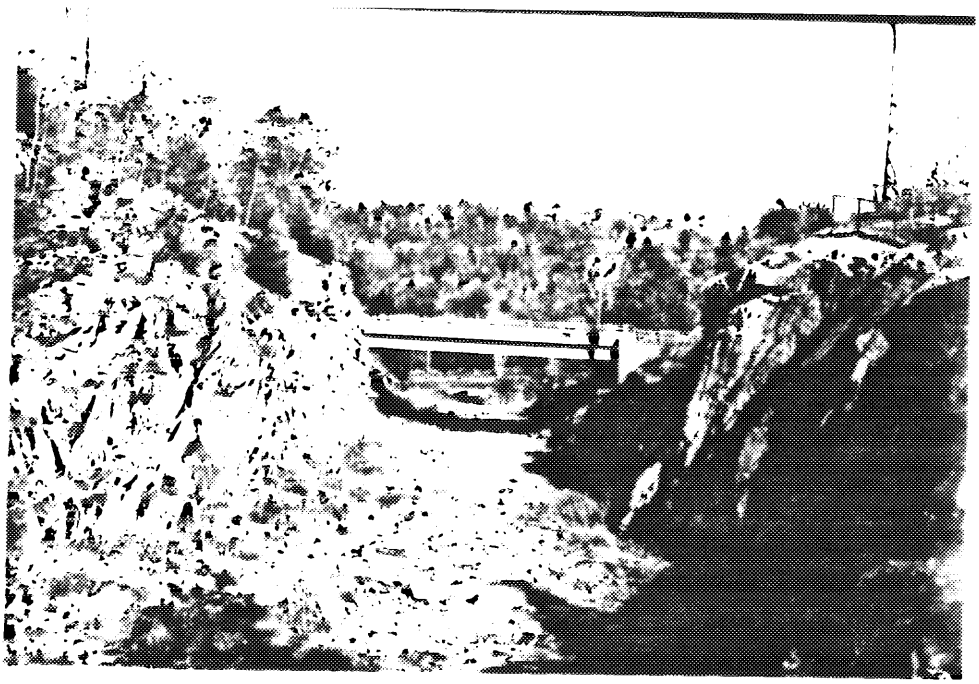


1. Hand placed riprap on upstream slope.

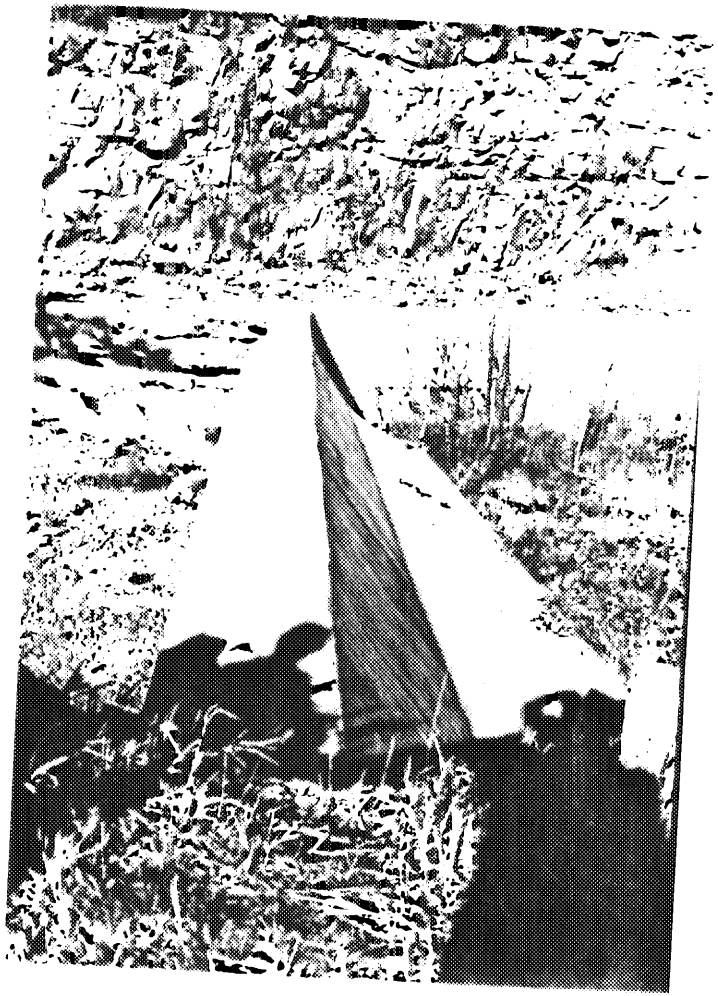
2. Downstream slope from left abutment.



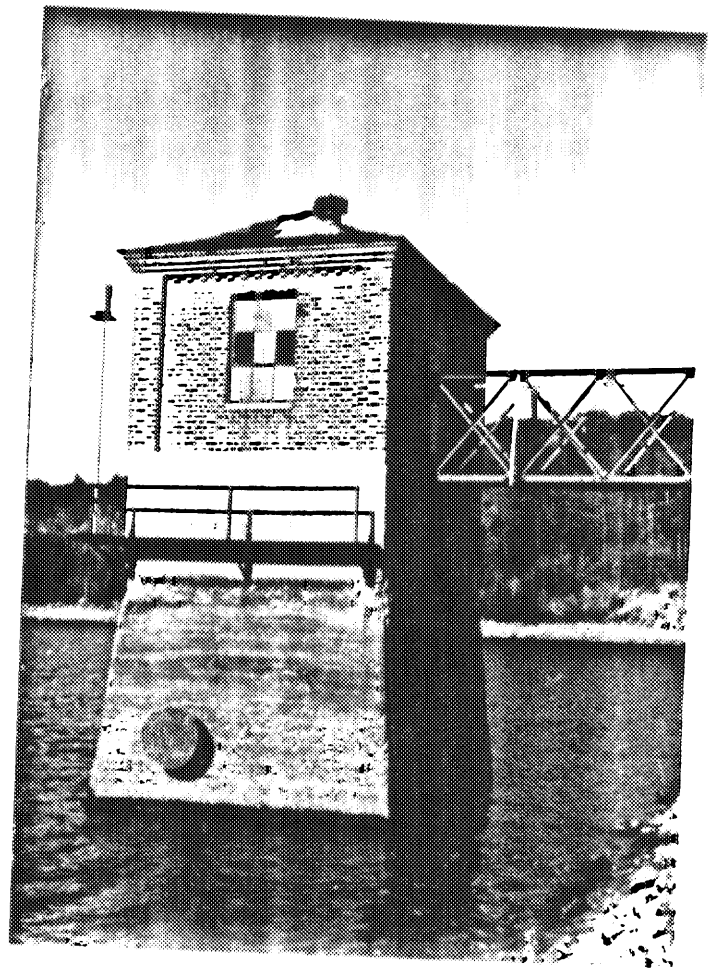
3. Main spillway and downstream chute.



4. Downstream channel and Route 272 bridge.



5. Auxiliary spillway from left end of embankment.

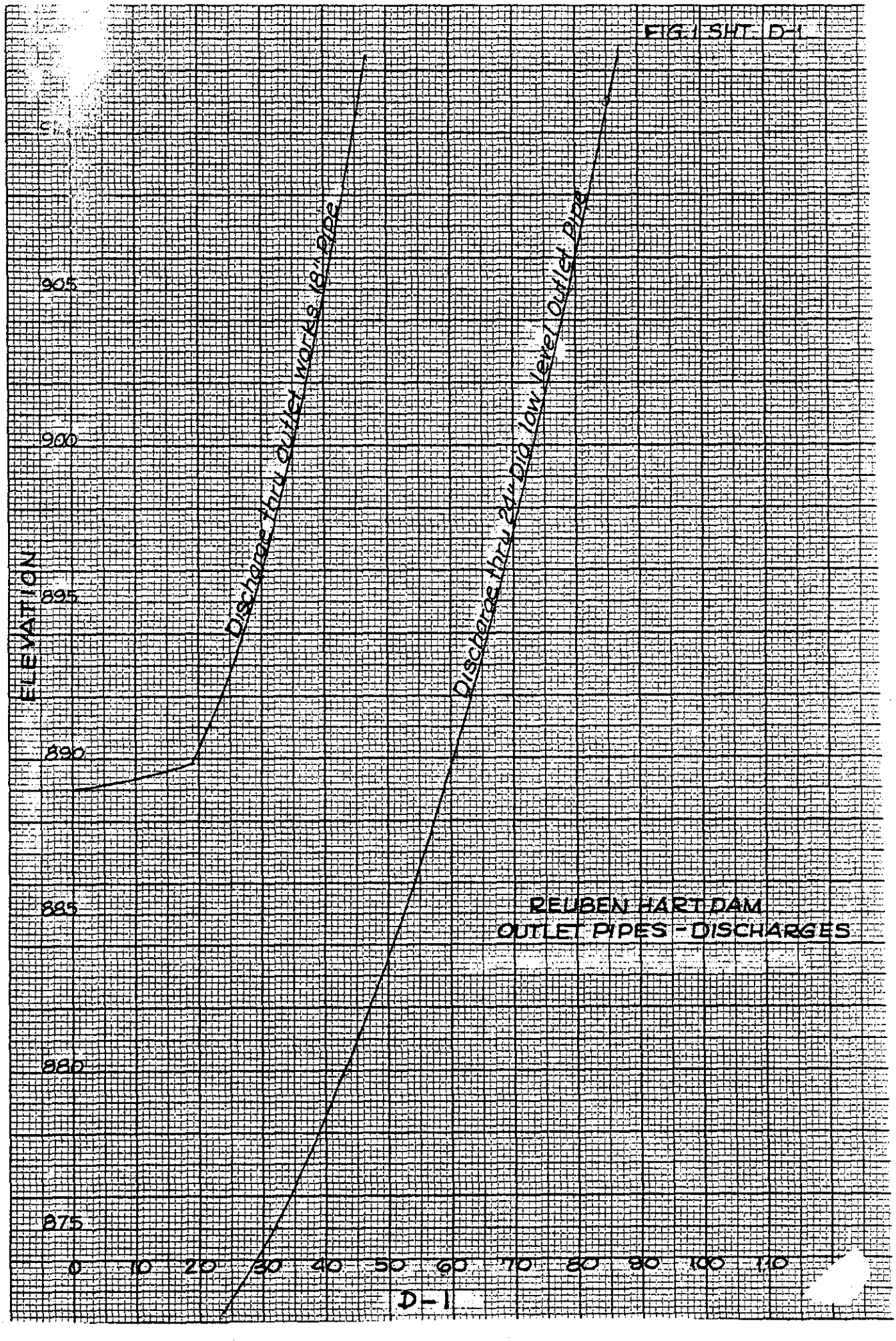


6. Outlet tower and gate house.

APPENDIX D

HYDROLOGIC & HYDRAULIC COMPUTATIONS

FIG. 1 SHT. D-1

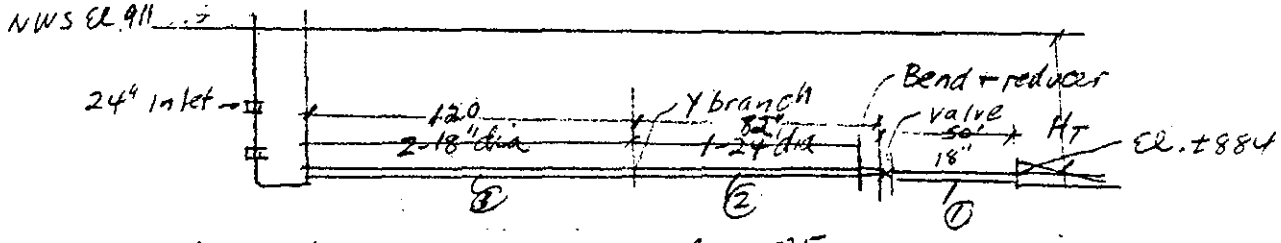

ELEVATION
905
900
895
890
885
880
875
Discharge thru outlet works 18" pipe
Discharge thru 24" dia low level Outlet pipe
0
10
20
30
40
50
60
70
80
90
100
110
REUBEN HART DAM
OUTLET PIPES - DISCHARGES
D-1

BY CHT DATE 12-18-78 [illegible] INC. SHEET NO. D-2 OF

CHKD. BY ____ DATE ____ INSPECTION OF DAM & RT. PROJECT ____

SUBJECT REUBEN HART RESERVOIR

OUTLET WORKS DISCHARGE - OUTLET PIPES



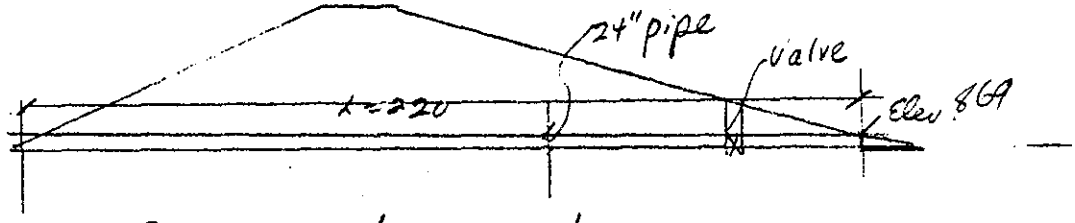
For 18" outlet pipe $A = 1.770'$ $\frac{f}{D} = \frac{.025}{2.5} = .01$

24" " " $A = 3.140'$ $\frac{f}{D} = \frac{0.028}{3} = .0093$

	L	Losses	Q = 30 $h_{v1} = 4.46$ $h_{v2} = 1.42$ $h_{v3} = 1.11$	Q = 40 $h_{v1} = 7.93$ $h_{v2} = 2.52$ $h_{v3} = 1.98$	Q = 45 $h_{v1} = 10.04$ $h_{v2} = 3.19$ $h_{v3} = 2.51$
Entrance 18"		$0.5 h_{v3}$	0.56	0.99	1.25
Friction 18" pipe	120	$.01 \frac{L}{D} h_{v3}$	1.33	2.38	3.01
Y branch 18" to 24"		$0.2 \Delta h_v$	0.06	0.11	0.14
Friction 24"	82	$0.0093 L h_{v2}$	1.08	1.92	2.43
Reducer 24" to 18"		$0.1 \Delta h_v$	0.30	0.54	0.69
Bend 18"		$0.2 h_{v1}$	0.89	1.59	2.01
Valve 18"		$0.2 h_{v1}$	0.89	1.59	2.01
Friction 18"	50	$0.01 L h_{v1}$	2.23	3.97	5.02
Exit 18"		$1.0 h_{v1}$	4.46	7.93	10.04
			11.8	21.02	26.60
El 890 Q = 0		Elev	895.8	905.0	910.6

Values plotted on Figure 1.

LOW LEVEL OUTLET PIPE



Losses - Entrance $0.5 h_v = 0.5 h_v$

Friction $.0093 L h_v = 2.0$

Valve $0.2 h_v = 0.2$

Exit $1.0 h_v = 1.0$

$h_L = 3.7 h_v$

$Q = A \sqrt{\frac{2gH_T}{3.7}}$

$A = 3.14$

Res El.	H_T	Q
911	42	85
905	36	79
900	31	73
890	21	60
880	11	43
875	6	32
872	3	23

Values plotted on Fig. 1

FIG 2 SHT. D-3

REUBEN HART DAM
SPILLWAY DISCHARGE CURVES

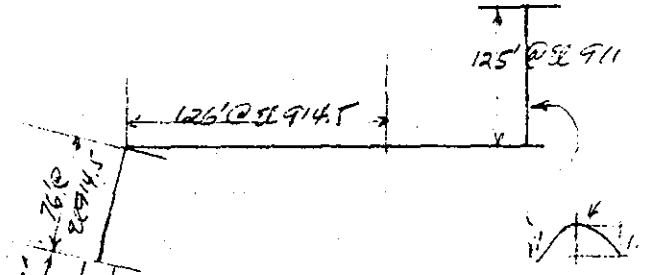
D-3

KEUFFEL & ESSER CO.
MADE IN U.S.A.

K&E STANDARD ® CROSS SECTION
10 X 10 TO THE HALF INCH

BY: CJH DATE 10-27-78 | LOUIS BERGER & ASSOCIATES INC. | SHEET NO. D-4 OF
CHKD. BY DATE | INSPECTION OF DAMS | R.I. | PROJECT
SUBJECT REUBEN HART RESERVOIR -

REUBEN HART RESERVOIR
Spillway Discharge



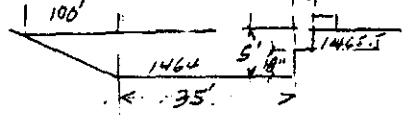
$\frac{1.69}{H_o} = 0.53\left(\frac{H}{L}\right)^{1.5}$

$H_o = 5.33$ say 5.0

← Spillway to Hall Meadows →						← Auxiliary Spillway L=202' →			← Dam L=965' →				
Elev	H	$\frac{H_e}{H_o}$	$\frac{C}{C_o}$	C	ΔQ	H	C	ΔQ	H	C	ΔQ	ΣQ	Remarks
911	0				0							0	Crest-Spillway to Hall Meadows Re
912	1	0.2	.855	3.29	411							411	
913	2	0.4	0.90	3.47	1227							1227	
914	3	0.6	0.94	3.62	2351							2351	
914.5	3.5	0.7	0.96	3.70	3028	0		0				3028	Crest-Auxiliary Spillway to River
915	4	0.8	0.97	3.73	3730	0.5	3.1	221				3951	
916	5	1.0	1.0	3.85	5381	1.5	3.2	1188				6569	
916.83	5.83	1.17	1.015	3.91	6880	2.33	3.3	2371	0		0	9251	Top of Dam
917	6	1.2	1.025	3.95	7257	2.5	3.32	2651	0.17	2.8	189	10097	
918	7	1.4	1.05	4.04	9353	3.5	3.4	4497	1.17	2.9	3542	17392	
919	8	1.6	1.07	4.12	11653	4.5	3.4	6556	2.17	2.9	8946	27155	

ABOVE VALUES USED FOR INPUT TO HEC PROGRAM ~~FLOOD~~ ROUTING

NORTH POND DAM -
SPILLWAY DISCHARGE



Spillway L=35								Dam L=265'				
Elev.	H	C	ΔQ	H	$C=2.5\frac{8}{11}$	Ave $\frac{8}{11}$	L	ΔQ	H	C	ΔQ	ΣQ	Remarks
1464	0	0		0	-							0	Spillway crest
1465	1	3.15	110	1	2.50	1.25	20	25				135	
1465.5	1.5	3.2	206	1.5	4.59	2.30	30	69				275	
1466	2	3.25	322	2	7.07	3.54	40	142				464	
1467	3	3.3	606	3	12.99	6.50	60	390				990	
1468	4	3.35	938	4	20.6	10.0	80	800				1738	
1469	5	3.4	1330	5	27.95	13.98	100	1398	0		0	2728	Top of dam
1470	6	3.4	1749	6	36.74	11.37	120	2204	1	2.8	742	4675	
1471	7	3.4	2204	7	46.30	23.15	140	3241	2	2.8	2100	7545	

ABOVE VALUES USED FOR INPUT TO HEC FLOOD ROUTING PROGRAM

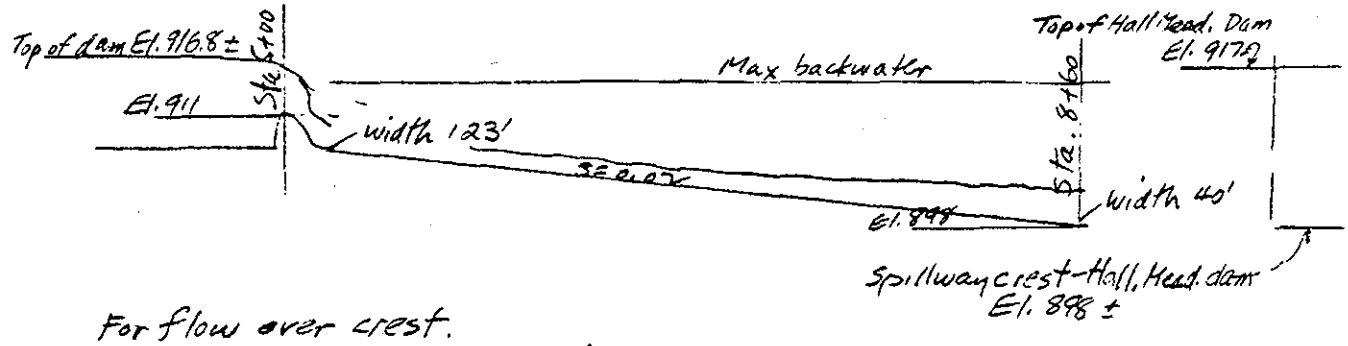
VALUES PLOTTED ON FIGURE 2.

BY CJK DATE 12-14-78 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. D-5 OF.

CHKD. BY _____ DATE _____ INSPECTION OF DAMS - Conn. & R.I PROJECT _____

SUBJECT REUBEN HART DAM - SPILLWAY

REUBEN HART DAM - SPILLWAY TO HALL MEADOW BROOK RESERVOIR



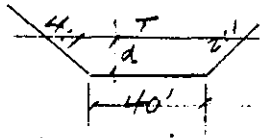
For flow over crest.

H = El. 916.8 − 911 = 5.8'

Max. submergence before discharge is affected = $\pm \frac{2}{3} H$ = 3.9'

Max backwater from Hall Meadow before disch. affected = El. 914.9

Flow at Sta 8+60 without backwater from Hall Meadow Brook Reservoir



For max. Q thru spillway @ W.S.El. 916.8 in Reuben Hart Reservoir

= 6900 c.f.s

@ Sta 8+60

Say d = 4.5' T = 67 A = 240.8 $v = \frac{6900}{240.8} = 28.66$ $h_v = 12.75$

Say 0.2 h_v loss, crest to Sta 8+60

Then 1.2 h_v = 15.3'

d = 4.5'

Bottom Elev. = 898

Gradient El 917.8 ≈ 916.8 OK.

∴ Converging chute will handle flow at supercritical velocity without affecting crest discharge.

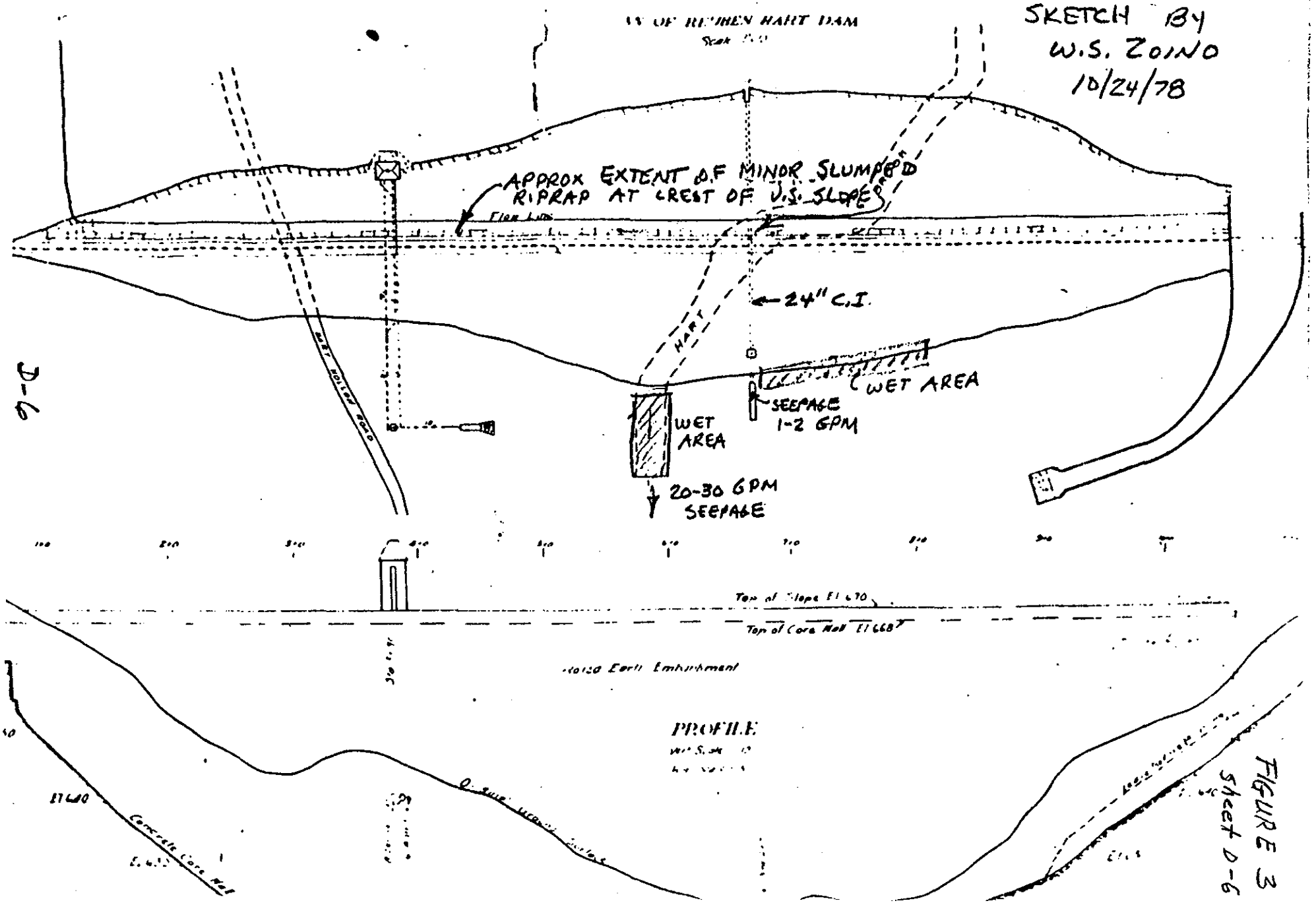
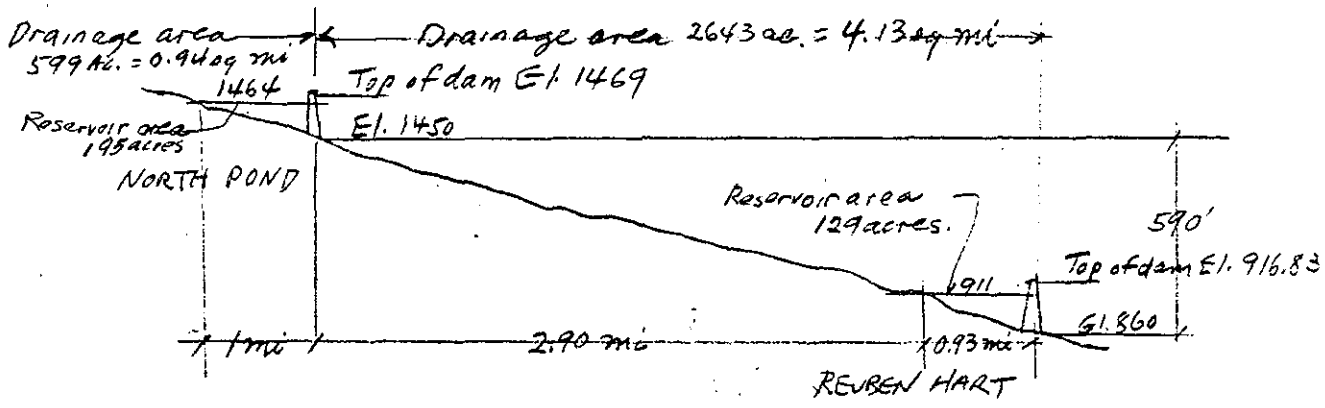


FIGURE 3
Sheet D-6

BY ejh DATE 10-27-78 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. D-7 OF

CHKD. BY _____ DATE _____ INSPECTION OF DAMS - Comm. + RE PROJECT _____

SUBJECT REUBEN HART DAM - HYDROLOGICAL DATA



REUBEN HART RESERVOIR

Elev.	Reservoir Area Ac.	Average Area	Δ Storage	Σ Surcharge
911	130			0
912	131	130.5	131	131
913	132	131.5	132	263
914	133	132.5	133	396
9145	135	134	67	463
915	137	136	68	531
916	139	138	138	669
916.83	141	140	116	985
917	143	142	124	809
918	145	144	144	953
919	147	146	146	1099
920	149	148	148	1247

NORTH POND RESERVOIR

Elev.	Reservoir Area Ac.	Average Area ac.	Δ Stor	Σ Surcharge
1464	195			0
1465	210	203	203	203
1465.5	218	214	107	310
1466	225	221	111	421
1467	240	232	232	653
1468	255	248	248	901
1469	270	262	262	1163
1470	285	278	278	1441
1471	300	292	292	1733

Downstream subbasin

$L = 3.83$ mi

$H = 590$

$S = 0.0292$ or 154'/mile

$\frac{L L_c}{\sqrt{S}} = 0.59$ $K = 4.4$

$Lag = K\left(\frac{L L_c}{\sqrt{S}}\right)^{.33} = 3.7$ hrs.

Unitgraph $T_p = 0.82 L_g + 0.40$ (3 min)

$= 0.82 \times 3.7 + 0.4(5) =$

$3.02 + 0.20 = 3.22$ hr.

Travel time North Pond Dam to Reuben Hart Res.

Elev.	Dist	H	S	S½	v	Travel time-min
1450						
1400	900	50	.056	.24	5.9	3
1350	2800	50	.018	.13	2.44	19
1300	4500	50	.011	.10	2.44	31
1250	1500	50	.033	.18	2.44	10
1200	660	50	.083	.29	5.9	2
1150	850	50	.058	.24	5.9	3
1100	606	50	.083	.29	5.9	2
1050	800	50	.062	.25	5.9	3
1000	1000	50	.05	.22	5.9	3
950	900	50	.056	.24	5.9	3
910	800	40	.05	.22	5.9	2
						81 min

Say 1.5 hrs.

Str El 1400 to 1250 — 300 / 10'

$d = 4'$ $A = 240$ $r = 2$ $r^{2/3} = 1.58$ $n = .125$

$S^{1/2} = .13$ $v = \frac{1.486}{.125} \times 1.58 \times .13 = 2.44$'/sec

Str 1250 to 910 — 120 / 10

$d = 6$ $A = 180$ $r = 3$ $r^{2/3} = 2.08$ $n = .125$

$S^{1/2} = .24$ $v = \frac{1.486}{.125} \times 2.08 \times .24 = 5.93$'/sec

BY SG DATE 11/1 | LOUIS BERGER & ASSOCIATES INC. | SHEET NO. D-8 OF

CHKD. BY DATE | Ruben Hart Reservoir | PROJECT W-189

SUBJECT Precipitation Data

Drainage Area - 4.13 sq. mi.
PMP for 6hr - 24.3 inches
PMP reduced 20% for basin fit = 19.4 inches

Time	%	Precip.	Δ	Rea. Δ	Infil. Loss	Runoff
				0.05		
.5	27	5.24	5.24	.97	.92	
1	38	7.37	2.13	.97	.92	
.5	46	8.92	1.55	1.16	1.11	
2	53	10.28	1.36	1.17	1.12	
.5	60	11.64	1.36	1.36	1.31	
3	67	13.0	1.36	1.55	1.5	
.5	73	14.16	1.16	2.13	2.08	
4	79	15.33	1.17	5.24	5.19	
.5	84.5	16.39	1.06	1.36	1.31	
5	90	17.46	1.07	1.36	1.31	
.5	95	18.43	.97	1.07	1.02	
6	100	19.4	.97	1.06	1.01	

BY ____ DATE 12/31 | **LOUIS BERGER & ASSOCIATES INC.** | SHEET NO. D-9 OF ____

CHKD. BY ____ DATE ____ | Ruben Hart Reservoir | PROJECT W-189

UBJECT North Rod PMP- Storm Inflow

Tc based on avg. vel. of overland flow from seven segments. Velocity range = 3-8 fps
Tc avg = 0.049 hr. Lag = (0.6) Tc = 0.029 hr
Tp = Lag + D/2, Time (D) = 0.5 hr
Tp = 0.28
$Q_p = \frac{484\,(A)\,Q}{Tp}$ = ~~1677~~ 1625 cfs / inch runoff

Neglect
Use instantaneous runoff from direct Precip.

DRAINAGE AREA = 0.94

Time (hr)	Runoff (inches)	× Qp (cfs)	= Inflow (cfs)	
~~.25~~	~~.45~~	~~1677~~	~~1324~~	
.50	~~.46~~ .92		1326	1543
~~.25~~	.46		1356	
1.	.46 .92		1356	1543
~~.25~~	.57		1621	
.50	~~.57~~ 1.11		1621	1861
~~.25~~	.57		1621	
2.	.56 1.12		1650	1878
~~.25~~	.67		1916	
.50	.65 1.31		1916	2197
~~.75~~	.68		2004	
3.	.81 1.5		2387	2576
~~.25~~	.91		2770	
.50	1.13 2.08		3330	3488
~~.75~~	3.56		10491	
4.	1.62 5.19		4774	8704
~~.25~~	.65		1916	
.50	.67 1.31		1916	2197
~~.75~~	.64		1916	
5.	.67 1.31		1916	2197
~~.25~~	.67		1976	
.50	.55 1.02		1621	1711
~~.75~~	.46		1356	
6.	.37 1.01		1091	1694

18.5"

BY ___ DATE 11/1 | LOUIS BERGER & ASSOCIATES INC. | SHEET NO. D-10 OF ___

CHKD. BY ___ DATE ___ | Reuben Hart Reservoir | PROJECT W-189

SUBJECT Lag & Unitgraph

$L = 3.83$ mi; $H = 590'$, $Slp = 154'/mi.$, $A = 4.13$ mi^2

$\frac{LLca}{\sqrt{S}} = 0.59$, from curve "B", Use Lag $= \frac{3.7}{3.1}$ hr.

Time (D) $= 0.5$ hr., $Tp = {}^{0.8\times}Lag + {}^{0.4\times}D/2 = 3.22$ hr

$Qp = \frac{484\ AQ}{Tp} = 621$ cfs

Time	T/Tp	Q/Qp	Discharge
.5	.182	.064	40
1	.364	.233	145
.5	.545	.506	314
2	.727	.811	504
.5	.909	.973	604
3	1.09	.982	610
.5	1.27	.864	537
4	1.45	.705	438
.5	1.64	.532	330
5	1.82	.41	255
.5	2.	.32	199
6	2.18	.248	154
.5	2.36	.192	119
7	2.55	.1425	88
.5	2.73	.1092	68
8	2.91	.0854	53
.5	3.09	.068	42
9	3.27	.0547	34
.5	3.41	.0399	25
10	3.64	.0310	19
.5	3.82	.0245	15
11	4.	.018	11
.5	4.18	.0148	9
12	4.36	.0115	7
.5	4.55	.0085	5
13	4.73	.0067	4
.5	4.91	.0049	3
14	5.09	.0032	2
.5	5.27	.0015	1

FIGURE 4
Sheet D-11

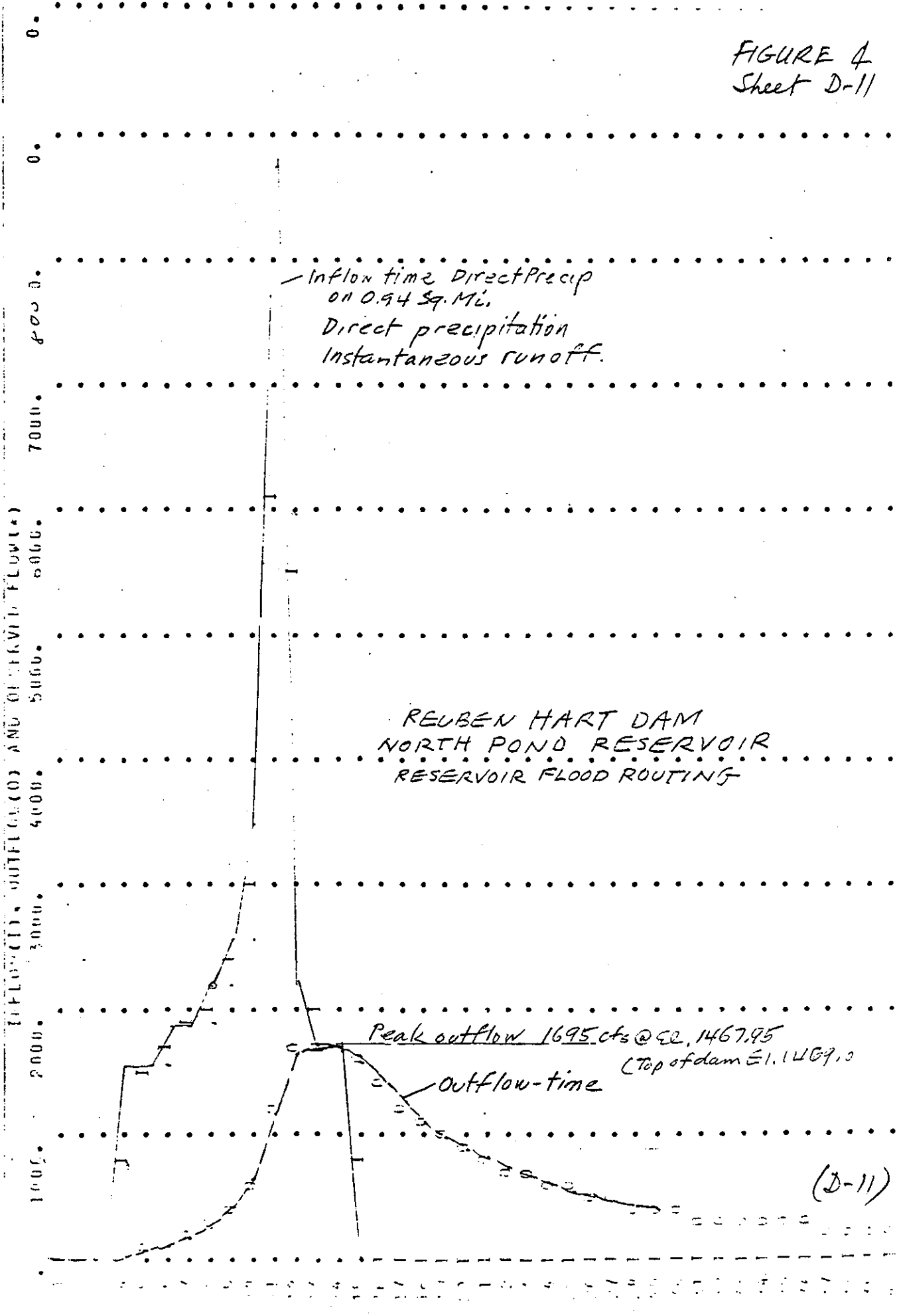
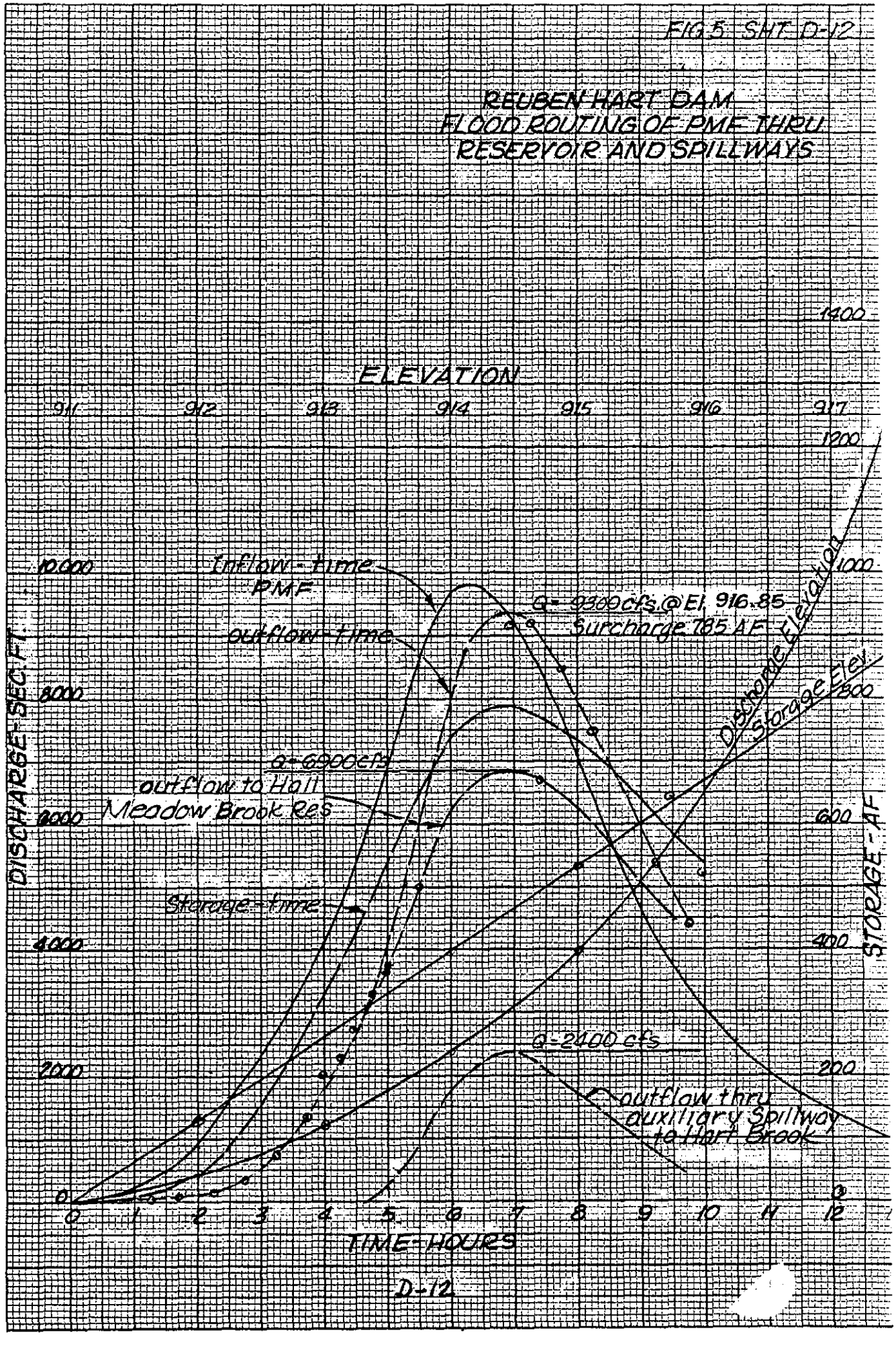


FIG 5 SHT D-12

REUBEN HART DAM
FLOOD ROUTING OF PMF THRU RESERVOIR AND SPILLWAYS



D-12

K&E STANDARD ® CROSS SECTION
10 X 10 TO THE HALF INCH

FIG. SHT D-13

REUBEN HART DAM
RESERVOIR EVACUATION FOR TRAPEZOIDAL
BREACH FAILURE OF DAM
20' BOTTOM WIDTH
1.4:1 SIDE SLOPES

ELEVATION FT. M.S.L.

870 875 880 885 890 895 900 905 910

RESERVOIR STORAGE-AF

0 200 400 600 800 1000 1200 1400 1600 1800 2000 2200

BREACH DISCHARGE - THOUSAND SEC.FT.

0 10 20 30 40

EVACUATION TIME - HOURS

0 5 10 15 20 25 30 35 40

Storage-Elevation

Discharge-Elevation

Storage-Time

Discharge-Time

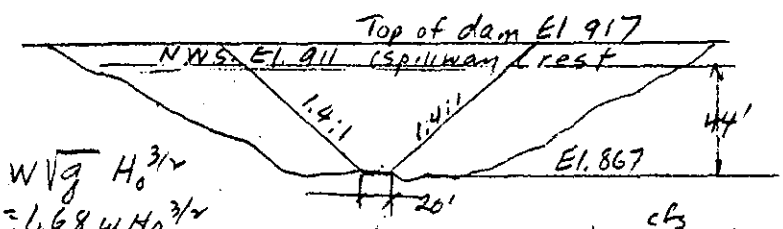
D-13

KE STANDARD @ CROSS SECTION
10 X 10 TO THE HALF INCH

BY. QJS DATE 12/19/78 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. D-14 OF

CHKD. BY _____ DATE _____ INSPECTION OF DAMS CONN & RI PROJECT _____

SUBJECT REUBEN HART DAM- HYDRAULICS OF BREACH FAILURE



$Q = \frac{8}{27} W \sqrt{g} H_0^{3/2}$

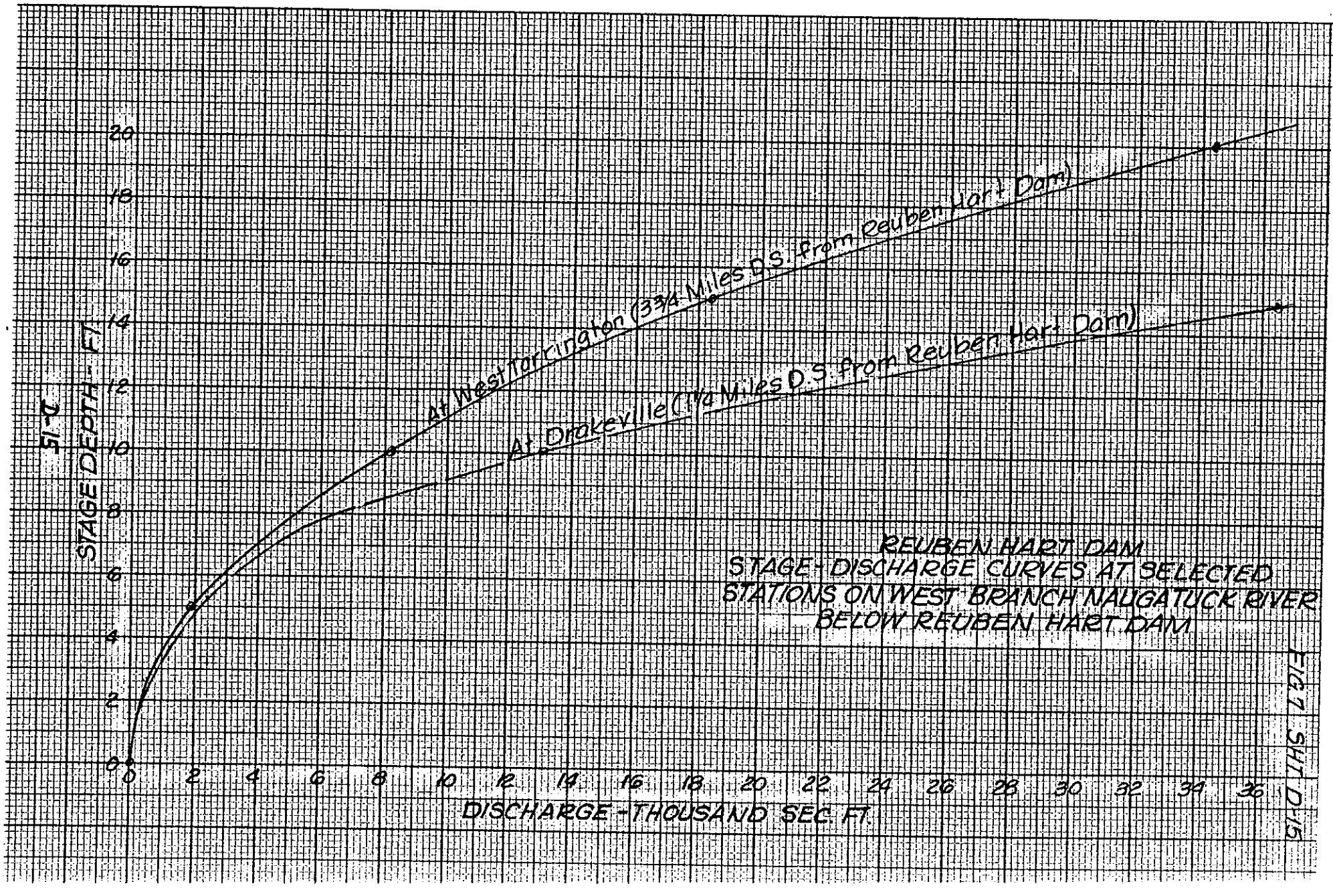
$= 1.68 W H_0^{3/2}$

Elev	H	cfs/ft	ΔQ ±20'	L	ΔQ	ΣQ	cfs Average Q	Acre Ft / min	ΔQ	Δ Evacuation time Minutes	Δ Σ-Hrs
911	44	490	9800	61.6	30,180	40,000					
905	38	393	7860	53.2	20,900	28,800	34,400	47.3	710	15.0	0.25
900	33	318	6360	46.2	14690	21,000	29,400	34.2	495	14.4	0.49
895	28	249	4980	39.2	9760	14,700	17,850	24.5	385	15.7	0.75
890	23	185	3700	32.2	5960	9,700	12,200	16.8	270	16.0	1.02
885	18	128	2560	25.2	3230	5,800	7,750	10,7	190	17.8	1.32
880	13	79	1580	18.2	1440	3,000	4,400	6.1	130	21.3	1.67
875	8	38	760	11.2	430	1,200	2100	2.9	80	27.6	2.13
870	3	9	180	4.2	40	200	700	1.0	35	35.0	2.71
867	0	0	0	0	0	0	100	0.1	6	60	3.71

RESERVOIR AREA-CAPACITY BELOW SPILLWAY CREST LEVEL

Elev	Area acres	Average Area-acres	H	ΔQ	ΣQ
867	0				0
870	4	2	3	6	6
875	12	7	5	35	41
880	21	16	5	80	121
885	33	26	5	130	251
890	45	38	5	190	441
895	65	54	5	270	711
900	90	77	5	385	1096
905	108	99	5	495	1591
911	1285	118.3	6	710	2301

THESE VALUES PLOTTED ON FIGURE 6.


REUBEN HART DAM
STAGE-DISCHARGE CURVES AT SELECTED STATIONS ON WEST BRANCH NAUGATUCK RIVER BELOW REUBEN HART DAM
At West Torrington (3¾ Miles D.S. from Reuben Hart Dam)
At Drakeville (1¼ Miles D.S. from Reuben Hart Dam)
STAGE DEPTH - FT.
DISCHARGE - THOUSAND SEC FT.
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
FIG 7 SHT 1 OF 1
2-15

BY. DJF DATE 12-19-78 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. D-16 OF

CHKD. BY DATE INSPECTION OF DAMS - CONN + RI. PROJECT

SUBJECT REUBEN HART DAM - DOWNSTREAM STAGE-DISCHARGE CURVES

STAGE DISCHARGE CURVE

AT DRAKEVILLE - 1 1/4 mile D.S from Reuben Hart Dam.

$n = 0.10$ $S = \frac{10}{1000} = 0.01$ $S^{1/2} = 0.10$ $Q = \frac{1.486}{n} A r^{2/3} S^{1/2}$

Elev.	Depth	Channel width	Δ Area	Σ Area	W.P	r	$r^{2/3}$	$Q = 1.486 A r^{2/3}$
740	0	10		0				0
745	5	300	775	775	300	2.58	1.88	2170
750	10	550	2125	2900	550	5.27	3.03	13,050
755	15	850	3500	6400	850	7.53	3.84	36,500

AT WEST TORRINGTON - INTERSECTION OF Highways (4) (272) (3 3/4 mi D.S. from Reuben H.)

$n = 0.10$ $S = \frac{10}{800} = .0125$ $S^{1/2} = 0.111$ $Q = 1.65 A r^{2/3}$

635	0	50		0				0
640	5	150	500	500	150	3.33	2.23	1840
645	10	200	875	1375	200	6.88	3.62	8210
650	15	300	1250	2625	300	8.75	4.25	18400
655	20	450	1875	4500	450	10.00	4.64	34400

THESE VALUES PLOTTED ON FIGURE 7

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*****************************
HEC-1 VERSION DATED JAN 1973
UPDATED AUG 74
CHANGE NO. 01
*****************************
```

RUBEN HART RESERVOIR DAM INSPECTION (W189)
BY D MULLIGAN & THOMAS CONWAY CHAPTER
NOVEMBER 1978

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
100	0	30	0	0	0	0	0	0	0

JOPER	NWT
3	0

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH TO NORTH POND

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
3	0	0	0	2	0	1

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	0	0.94	0.0	0.94	0.0	0.0	0	0	0

Transport time, North Pond to Reuben Hart - 1½ hrs

INPUT HYDROGRAPH

0.	0.	0.	1543.	1543.	1861.	1878.	2197.	2516.	3488.
8704.	2197.	1711.	1694.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	8704.	2444.	611.	293.	29332.
INCHES		24.19	24.19	24.19	24.19
AC-FT		1213.	1213.	1213.	1213.

OVF

STATION 5

INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)

0. 1000. 2000. 3000. 4000. 5000. 6000. 7000. 8000. 9000. 0. 0. 0.

Time - 30 min intervals

OVN

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

FLOOD ROUTING

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
33	1	0	0	2	0	1

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME
0.0	0.0	0.0	1	0

NSTPS	NSTOL	LAG	AMSKK	X	TSK	STORA
1	0	0	0.0	0.0	0.0	-1.

STORAGE=	0.	203.	310.	421.	653.	901.	1163.	1441.	1733.	0.
OUTFLOW=	0.	135.	275.	464.	990.	1738.	2728.	4695.	7545.	0.

TIME	EOP STOR	AVG IN	EOP OUT
1	0.	0.	0.
2	0.	0.	0.
3	0.	0.	0.
4	31.	772.	21.
5	93.	1543.	62.
6	160.	1702.	107.
7	232.	1870.	173.
8	307.	2038.	271.
9	390.	2357.	411.
10	493.	3002.	627.
11	708.	6096.	1155.
12	875.	5451.	1659.
13	886.	1954.	1694.
14	887.	1703.	1695.
15	854.	847.	1596.
16	792.	0.	1408.
17	737.	0.	1243.
18	689.	0.	1097.
19	646.	0.	974.
20	607.	0.	886.
21	572.	0.	807.
22	540.	0.	735.
23	511.	0.	669.
24	485.	0.	609.
25	461.	0.	555.
26	439.	0.	505.
27	419.	0.	461.
28	401.	0.	430.
29	384.	0.	400.
30	368.	0.	373.
31	353.	0.	348.
32	339.	0.	324.
33	326.	0.	302.
34	314.	0.	282.
35	303.	0.	265.
36	292.	0.	251.
37	282.	0.	238.
38	272.	0.	226.
39	263.	0.	214.

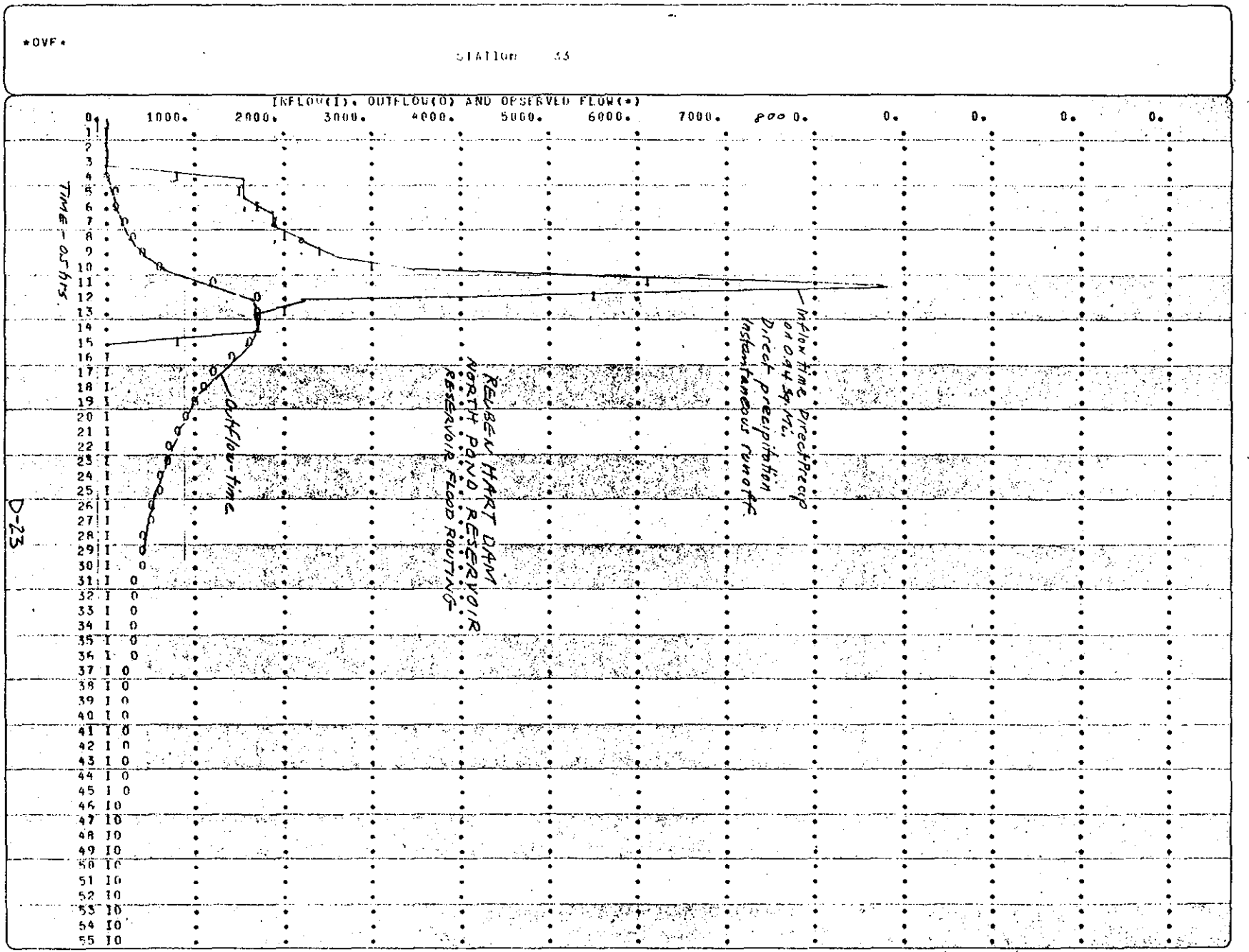
40	255.	0.	202.
41	246.	0.	192.
42	239.	0.	182.
43	231.	0.	172.
44	224.	0.	163.
45	218.	0.	154.
46	212.	0.	146.
47	206.	0.	139.
48	200.	0.	133.
49	195.	0.	129.
50	189.	0.	126.
51	184.	0.	123.
52	179.	0.	119.
53	174.	0.	116.
54	170.	0.	113.
55	165.	0.	110.
56	161.	0.	107.
57	156.	0.	104.
58	152.	0.	101.
59	148.	0.	98.
60	144.	0.	96.
61	140.	0.	93.
62	136.	0.	91.
63	133.	0.	88.
64	129.	0.	86.
65	125.	0.	83.
66	122.	0.	81.
67	119.	0.	79.
68	116.	0.	77.
69	112.	0.	75.
70	109.	0.	73.
71	106.	0.	71.
72	103.	0.	69.
73	101.	0.	67.
74	98.	0.	65.
75	95.	0.	63.
76	93.	0.	62.
77	90.	0.	60.
78	88.	0.	58.
79	85.	0.	57.
80	83.	0.	55.
81	81.	0.	54.
82	79.	0.	52.
83	76.	0.	51.
84	74.	0.	49.
85	72.	0.	48.
86	70.	0.	47.
87	69.	0.	46.
88	67.	0.	44.
89	65.	0.	43.
90	63.	0.	42.
91	61.	0.	41.
92	60.	0.	40.
93	58.	0.	39.
94	57.	0.	38.
95	55.	0.	37.
96	54.	0.	36.
97	52.	0.	35.
98	51.	0.	34.
99	49.	0.	33.
100	48.	0.	32.

D-21

Paste on summary 1

SUB 28187.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1695.	1247.	523.	282.	28187.
INCHES		12.53	20.69	23.25	23.25
AC-FT		618.	1037.	1165.	1165.


OVF
STATION 55
INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)
0. 1000. 2000. 3000. 4000. 5000. 6000. 7000. 800 0. 0. 0. 0. 0.
TIME - 05 hrs.
Outflow-time
Inflow time PrecipPrecip on 0.94 Sq.Mi.
Direct precipitation
Instantaneous runoff
RELBEN HART DAM
NORTH POND RESERVOIR
RESERVOIR FLOOD ROUTING

OVN

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INFLOW TO KUPER HART RESERVOIR NOT INCLUDING NORTH POND

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
333	0	0	0	2	0	1

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
0	-1	4.13 D.A.	0.0	4.13	0.0	0.0	0	0	0

PRECIP DATA

NP	STORM	DAJ	DAK
12	0.0	0.0	0.0

PRECIP PATTERN

½ hr. precip 0.92 0.92 1.11 1.12 1.31 1.50 2.08 5.19 1.31 1.31 1.02 1.01 } 16.8"

LOSS DATA

STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	0.0	0.0

GIVEN UNIT GRAPH, NUHGG= 29

40. 148. 314. 504. 604. 610. 537. 438. 330. 255.
199. 154. 119. 88. 68. 53. 42. 34. 25. 19.
15. 11. 9. 7. 5. 4. 3. 2. 1.

UNIT GRAPH TOTALS 4635. CFS OR 0.87 INCHES OVER THE AREA

D.24

RECESSION DATA

STRTQ= 0.0 QRCSN= 0.0 RTIOR= 1.00

END-OF-PERIOD FLOW

TIME	RAIN	EXCS	COMP Q
1	0.92	0.92	37.
2	0.92	0.92	170.
3	1.11	1.11	567.
4	1.12	1.12	958.
5	1.31	1.31	1583.
6	1.50	1.50	2278.
7	2.08	2.08	3002.
8	5.19	5.19	3891.
9	1.31	1.31	4991.
10	1.31	1.31	6251.
11	1.02	1.02	7407.
12	1.01	1.01	8020.
13	0.0	0.0	8048.
14	0.0	0.0	7533.
15	0.0	0.0	6679.
16	0.0	0.0	5595.
17	0.0	0.0	4556.
18	0.0	0.0	3607.
19	0.0	0.0	2802.
20	0.0	0.0	2153.
21	0.0	0.0	1648.
22	0.0	0.0	1273.
23	0.0	0.0	984.

24	0.0	0.0	765.
25	0.0	0.0	593.
26	0.0	0.0	455.
27	0.0	0.0	352.
28	0.0	0.0	273.
29	0.0	0.0	208.
30	0.0	0.0	159.
31	0.0	0.0	121.
32	0.0	0.0	90.
33	0.0	0.0	67.
34	0.0	0.0	49.
35	0.0	0.0	34.
36	0.0	0.0	21.
37	0.0	0.0	11.
38	0.0	0.0	6.
39	0.0	0.0	3.
40	0.0	0.0	1.
41	0.0	0.0	0.
42	0.0	0.0	0.
43	0.0	0.0	0.
44	0.0	0.0	0.
45	0.0	0.0	0.
46	0.0	0.0	0.
47	0.0	0.0	0.
48	0.0	0.0	0.
49	0.0	0.0	0.
50	0.0	0.0	0.
51	0.0	0.0	0.
52	0.0	0.0	0.
53	0.0	0.0	0.
54	0.0	0.0	0.
55	0.0	0.0	0.
56	0.0	0.0	0.
57	0.0	0.0	0.
58	0.0	0.0	0.
59	0.0	0.0	0.
60	0.0	0.0	0.
61	0.0	0.0	0.
62	0.0	0.0	0.
63	0.0	0.0	0.
64	0.0	0.0	0.
65	0.0	0.0	0.
66	0.0	0.0	0.
67	0.0	0.0	0.
68	0.0	0.0	0.
69	0.0	0.0	0.
70	0.0	0.0	0.
71	0.0	0.0	0.
72	0.0	0.0	0.
73	0.0	0.0	0.
74	0.0	0.0	0.
75	0.0	0.0	0.
76	0.0	0.0	0.
77	0.0	0.0	0.
78	0.0	0.0	0.
79	0.0	0.0	0.
80	0.0	0.0	0.
81	0.0	0.0	0.
82	0.0	0.0	0.
83	0.0	0.0	0.
84	0.0	0.0	0.

D-25

85	0.0	0.0	0.
86	0.0	0.0	0.
87	0.0	0.0	0.
88	0.0	0.0	0.
89	0.0	0.0	0.
90	0.0	0.0	0.
91	0.0	0.0	0.
92	0.0	0.0	0.
93	0.0	0.0	0.
94	0.0	0.0	0.
95	0.0	0.0	0.
96	0.0	0.0	0.
97	0.0	0.0	0.
98	0.0	0.0	0.
99	0.0	0.0	0.
100	0.0	0.0	0.
SUM	18.80	16.80	87139.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	8048.	5798.	1815.	871.	87137.
INCHES		13.06	16.36	16.36	16.36
AC-FT		2877.	3603.	3603.	3603.

OVF

STATION 333

INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)

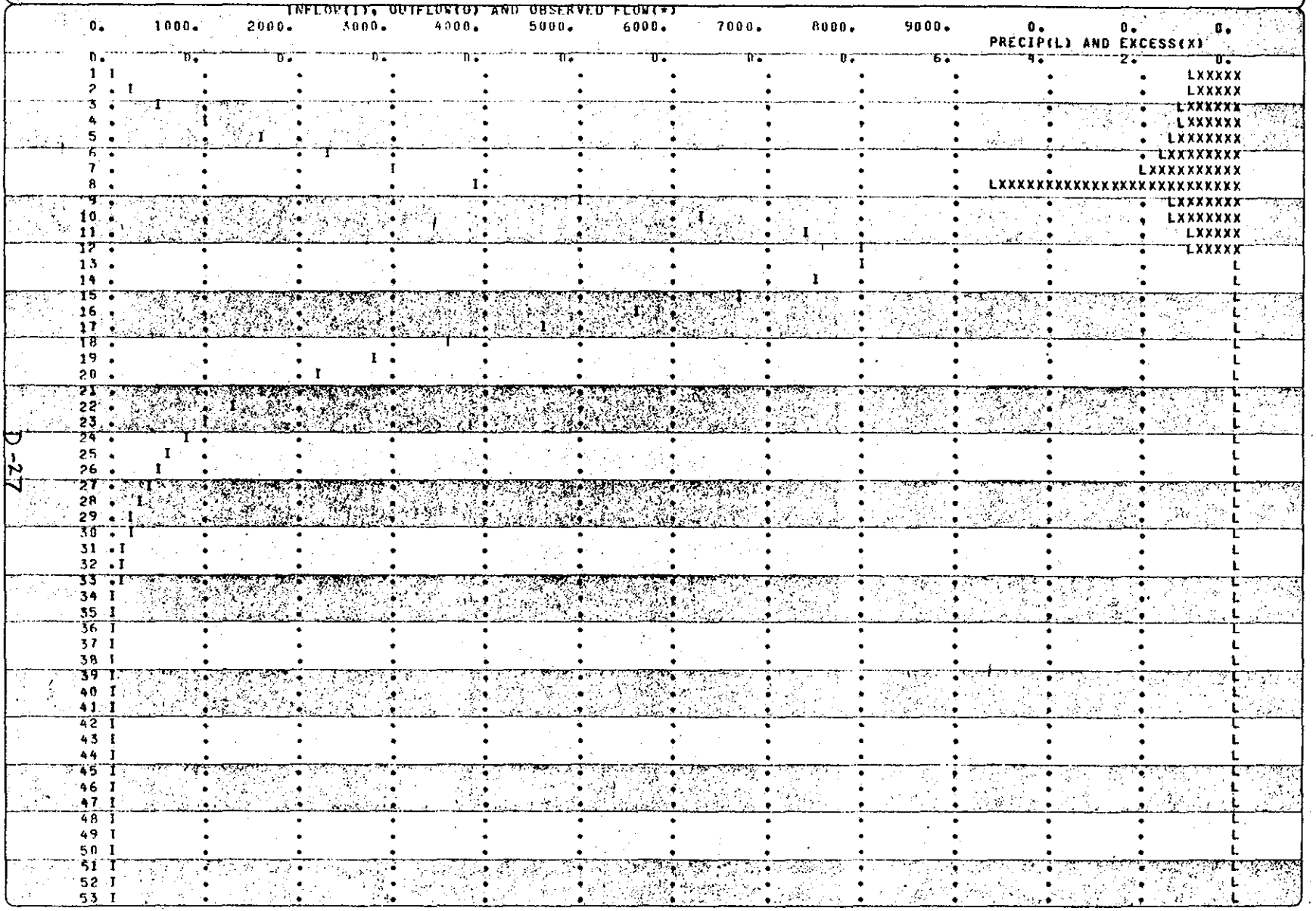
0. 1000. 2000. 3000. 4000. 5000. 6000. 7000. 8000. 9000.

0. 0. 0. 0. 0. 0. 0. 0. 0. 6.

0. 0. 0.

PRECIP(L) AND EXCESS(X)

0. 0. 0.



OVN

********** ********** ********** ********** **********

COMBINE HYDROGRAPHS

COMBINE HYDROGRAPHS

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
3333	2	0	0	2	0	1

SUM OF 2 HYDROGRAPHS AT 3333

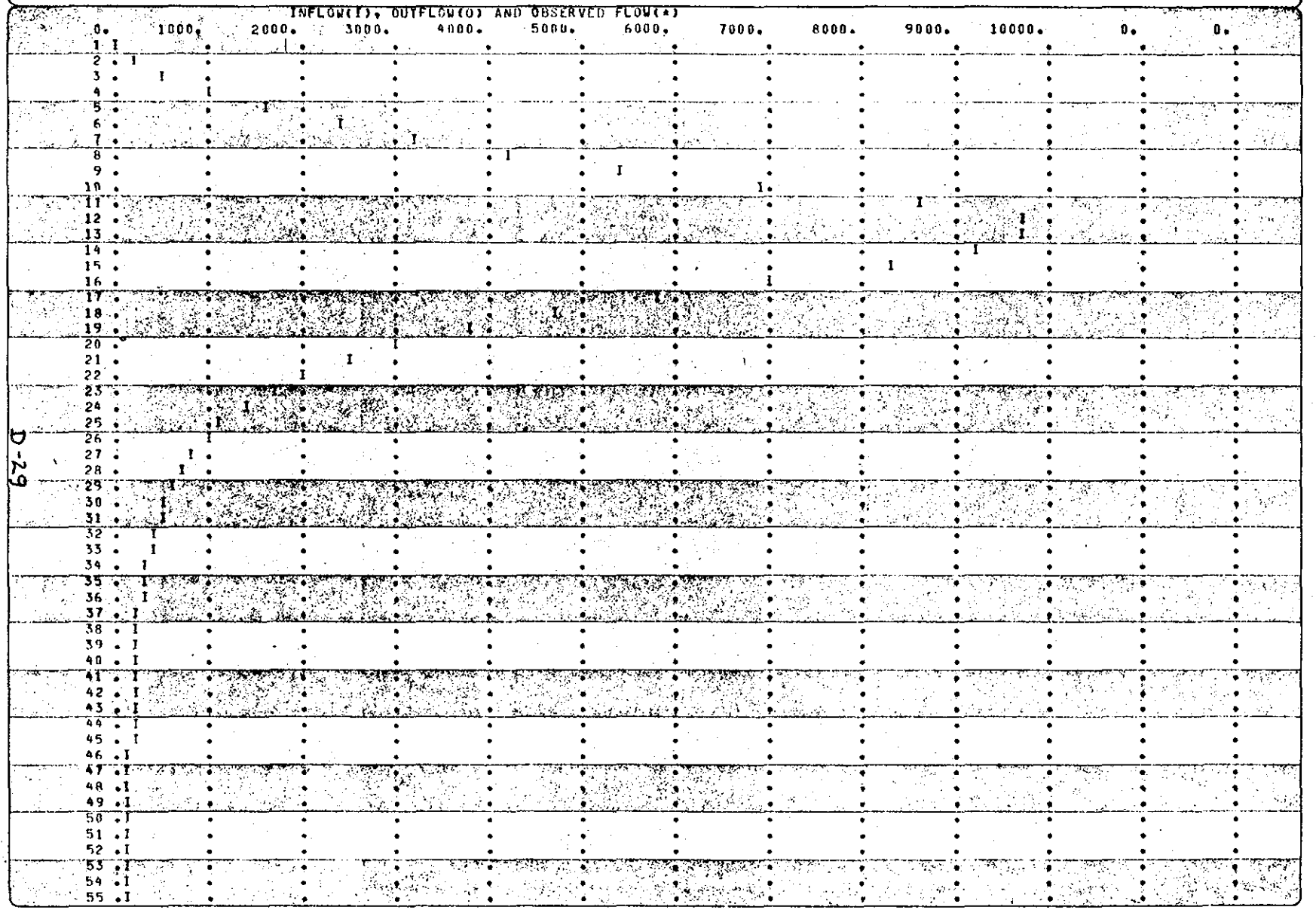
37.	170.	467.	979.	1645.	2385.	3175.	4162.	5403.	6878.
8562.	9679.	9742.	9228.	8274.	7003.	5799.	4704.	3775.	3040.
2455.	2008.	1653.	1372.	1147.	960.	812.	702.	608.	532.
468.	414.	369.	331.	299.	272.	249.	232.	217.	203.
192.	182.	172.	163.	154.	146.	139.	133.	129.	126.
123.	119.	116.	113.	110.	107.	104.	101.	98.	96.
93.	91.	88.	86.	83.	81.	79.	77.	75.	73.
71.	69.	67.	65.	63.	62.	60.	58.	57.	55.
54.	52.	51.	49.	48.	47.	46.	44.	43.	42.
41.	40.	39.	38.	37.	36.	35.	34.	33.	32.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	9742.	6934.	2329.	1153.	115323.
INCHES		12.72	17.09	17.63	17.63
ACRE-FT		3440.	4622.	4768.	4768.

D-28

OVF

STATION 3335



OVN

HYDROGRAPH ROUTING

FLOOD ROUTING

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
33333	1	0	0	2	0	1

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME
0.0	0.0	0.0	1	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA
1	0	0	0.0	0.0	0.0	-1.

STORAGE=	0.	131.	263.	396.	530.	666.	804.	944.	1086.	1230.	1376.
OUTFLOW=	0.	411.	1227.	2351.	3028.	3951.	6569.	9251.	10097.	17392.	27155.

TIME	EOP STOR	AVG IN	EOP OUT
1	139.	31.	37.
2	133.	103.	126.
3	129.	318.	402.
4	141.	723.	474.
5	172.	1312.	664.
6	221.	2015.	970.
7	287.	2780.	1428.
8	366.	3668.	2094.
9	464.	4782.	2696.
10	591.	6140.	3443.
11	732.	7720.	5196.
12	848.	9121.	7413.
13	916.	9711.	8716.
14	939.	9485.	9152.
15	927.	8751.	8924.
16	889.	7639.	8195.
17	836.	6401.	7178.
18	779.	5252.	6089.
19	724.	4240.	5047.
20	675.	3407.	4124.
21	627.	2747.	3688.
22	574.	2231.	3330.
23	520.	1830.	2976.
24	465.	1513.	2700.
25	411.	1260.	2428.
26	362.	1055.	2063.
27	321.	886.	1713.
28	287.	757.	1429.
29	260.	655.	1206.
30	236.	570.	1062.
31	216.	500.	935.
32	198.	441.	823.
33	182.	392.	725.
34	168.	350.	640.
35	156.	315.	567.
36	146.	286.	503.
37	137.	261.	448.
38	129.	241.	401.
39	123.	224.	361.

← Manual routing values

20
50
70
110
220
550
1050
1850
2700

Inconsistent with graphic manual flood routing.

D-30

40	117.	210.	327.
41	113.	198.	298.
42	109.	187.	272.
43	105.	177.	251.
44	102.	168.	232.
45	99.	159.	215.
46	97.	150.	201.
47	95.	142.	187.
48	93.	136.	176.
49	91.	131.	166.
50	90.	128.	157.
51	89.	124.	150.
52	88.	121.	143.
53	87.	118.	137.
54	86.	114.	132.
55	85.	111.	127.
56	84.	108.	123.
57	84.	105.	119.
58	83.	103.	115.
59	83.	100.	112.
60	82.	97.	108.
61	82.	94.	105.
62	81.	92.	102.
63	81.	89.	99.
64	80.	87.	97.
65	80.	85.	94.
66	79.	82.	91.
67	79.	80.	89.
68	78.	78.	86.
69	78.	76.	84.
70	78.	74.	82.
71	77.	72.	79.
72	77.	70.	77.
73	77.	68.	75.
74	76.	66.	73.
75	76.	64.	71.
76	76.	63.	69.
77	75.	61.	67.
78	75.	59.	65.
79	75.	58.	64.
80	75.	56.	62.
81	74.	54.	60.
82	74.	53.	59.
83	74.	52.	57.
84	73.	50.	55.
85	73.	49.	54.
86	73.	47.	52.
87	73.	46.	51.
88	73.	45.	50.
89	72.	44.	48.
90	72.	43.	47.
91	72.	41.	46.
92	72.	40.	45.
93	72.	39.	43.
94	71.	38.	42.
95	71.	37.	41.
96	71.	36.	40.
97	71.	35.	39.
98	71.	34.	38.
99	70.	33.	37.
100	70.	32.	36.

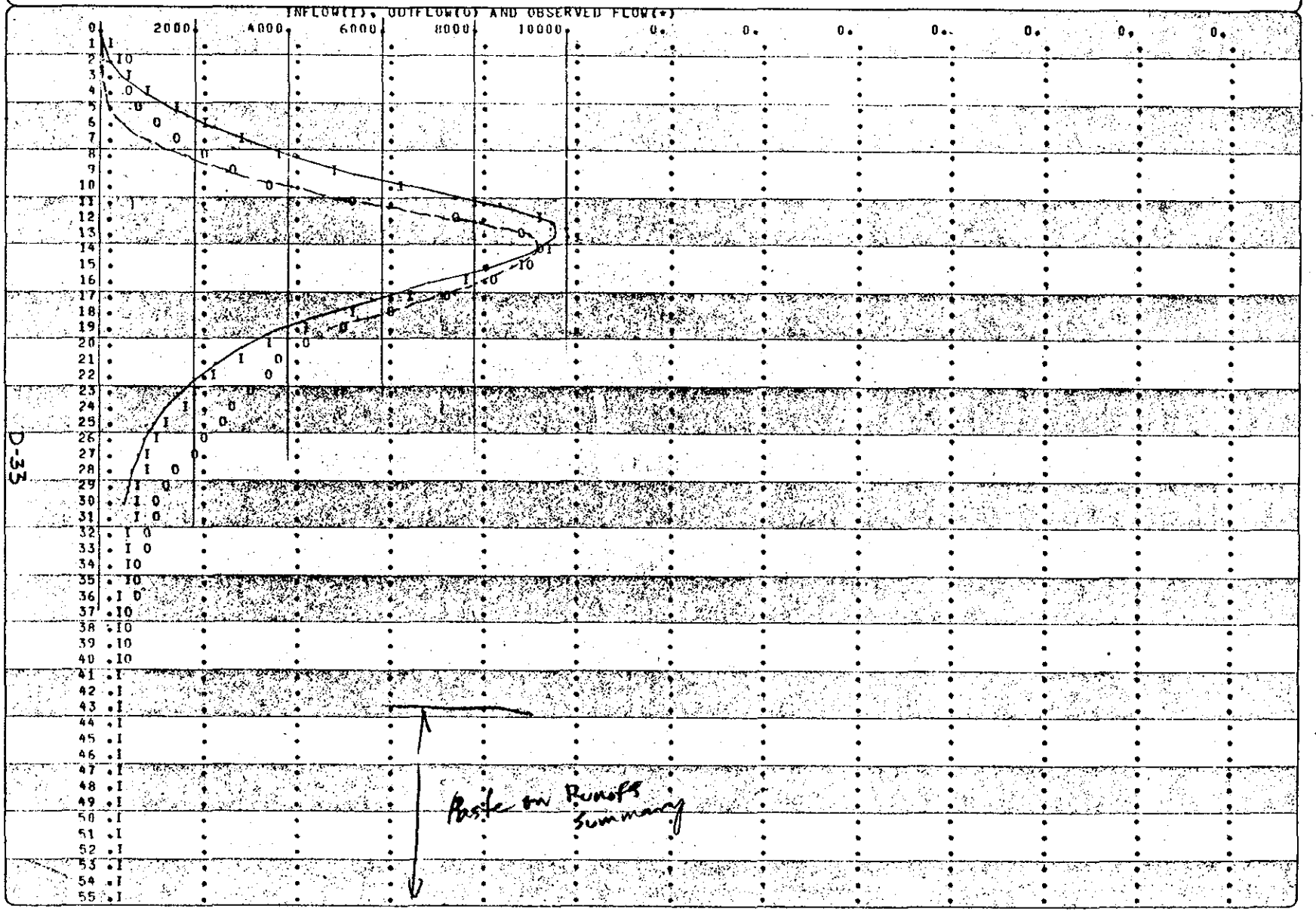
Add next page pasted on

SUB 116981.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	9152.	6430.	2353.	1176.	116981.
INCHES		11.80	17.27	17.89	17.89
AC-FT		3199.	4670.	4836.	4836.

OVF

STATION 55333



RUNOFF SUMMARY, AVERAGE FLOW

		PEAK	6-HOUR	24-HOUR	72-HOUR	AREA
HYDROGRAPH AT	3	8704.	2444.	611.	293.	0.94
ROUTED TO	33	1695.	1246.	523.	282.	0.94
HYDROGRAPH AT	333	8648.	5798.	1815.	871.	4.13
2 COMBINED	3333	9742.	6934.	2329.	1153.	5.07
ROUTED TO	33333	9152.	6430.	2353.	1170.	5.07

APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

INVENTORY OF DAMS IN THE UNITED STATES

STATE	IDENTITY NUMBER	DIVISION	STATE	COUNTY	CONGR DIST.	STATE	COUNTY	CONGR DIST.	NAME	LATITUDE (NORTH)	LONGITUDE (WEST)	REPORT DATE DAY | MO | YR
CT	9[illegible]	NED	CT	005	06				REUBEN HART RESERVOIR DAM	4152.1	7310.2	29DEC78

POPULAR NAME	NAME OF IMPOUNDMENT
	REUBEN HART RESERVOIR

REGION	BASIN	RIVER OR STREAM	NEAREST DOWNSTREAM CITY-TOWN-VILLAGE	DIST FROM DAM (MI.)	POPULATION
01	07	HART BROOK	DRAKEVILLE	1	2000

TYPE OF DAM	YEAR COMPLETED	PURPOSES	STRUC. HEIGHT (FT.)	HYDRAU. HEIGHT (FT.)	IMPOUNDING CAPACITIES MAXIMUM (ACRE-FT.)	IMPOUNDING CAPACITIES NORMAL (ACRE-FT.)	DIST	OWN	FED R	PRV/FED	SCS A	VER/DATE
RECTPG	1933	S	50	50	3100	2300	NED	N	N	N	N	15JAN79

REMARKS

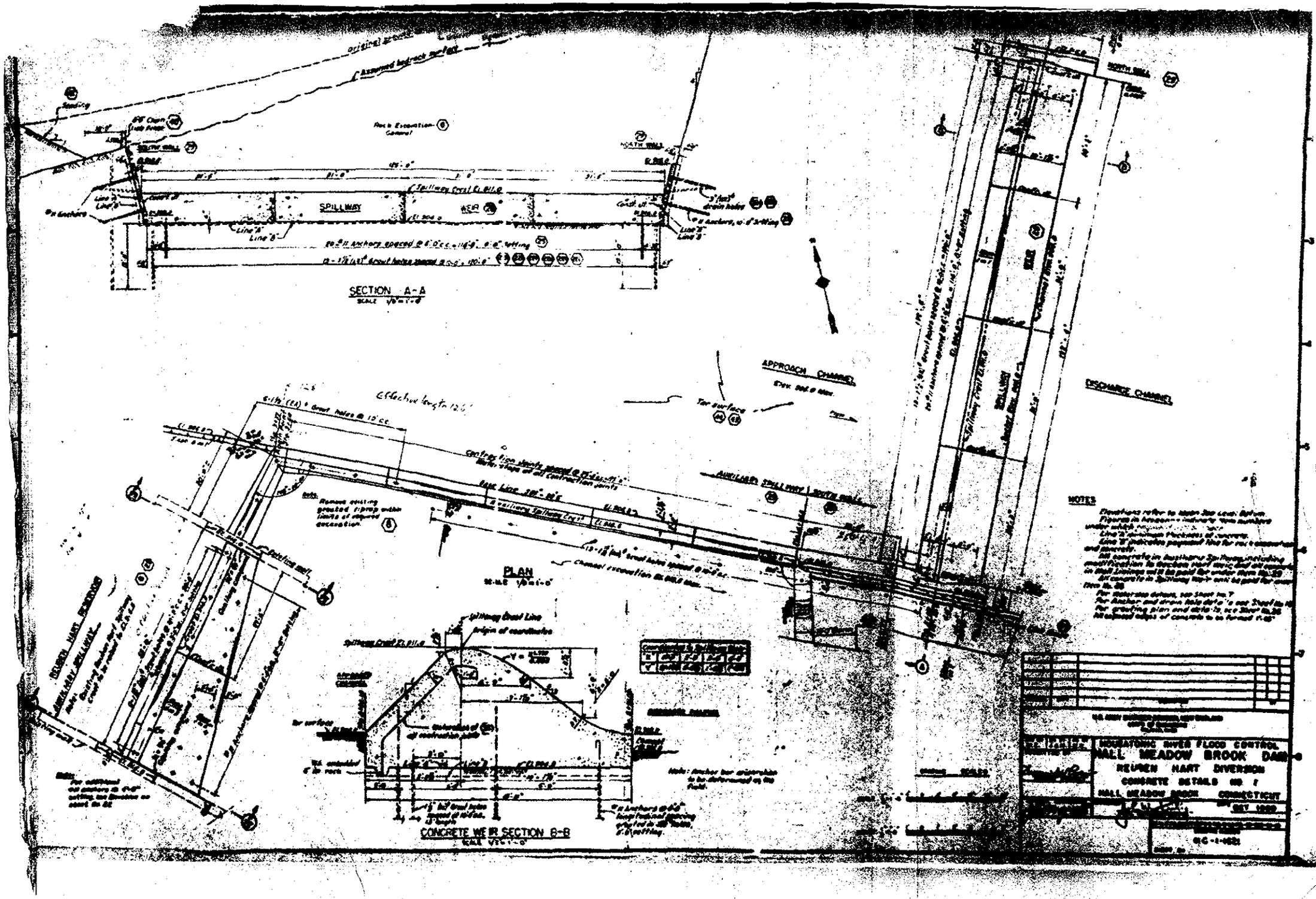
D/S HAS	SPILLWAY CREST LENGTH	SPILLWAY TYPE	SPILLWAY WIDTH (FT.)	MAXIMUM DISCHARGE (FT.)	VOLUME OF DAM (CY)	POWER CAPACITY INSTALLED (MW)	POWER CAPACITY PROPOSED (MW)	NAVIGATION LOCKS NO	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)
Y	1000	U	125	7000	236111											

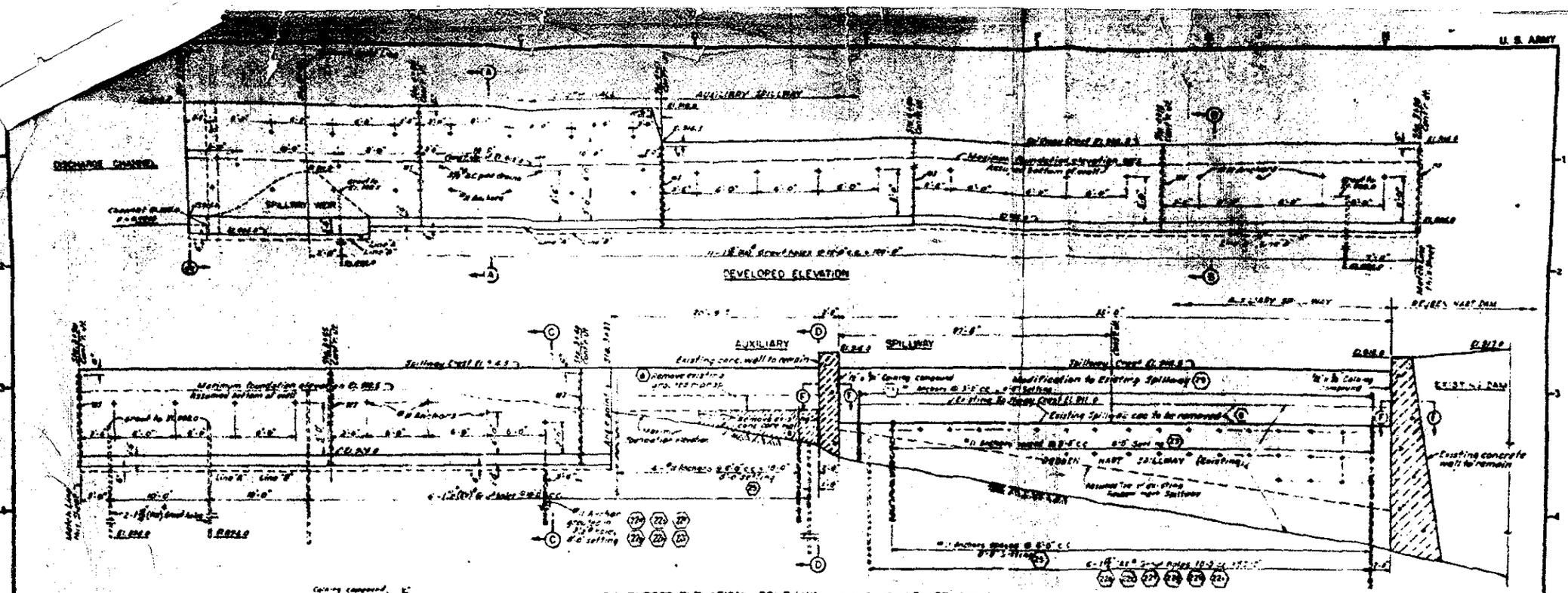
OWNER	ENGINEERING BY	CONSTRUCTION BY
TORRINGTON WATER CO.	WILLIAM G. SMITH	O+G INDUSTRIES

REGULATORY AGENCY			
DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
NONE	NONE	NONE	NONE

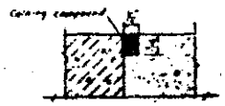
INSPECTION BY	INSPECTION DATE DAY | MO | YR	AUTHORITY FOR INSPECTION
LOUIS BERGER + ASSOCIATES, INC.	240CT78	PL92-367

REMARKS

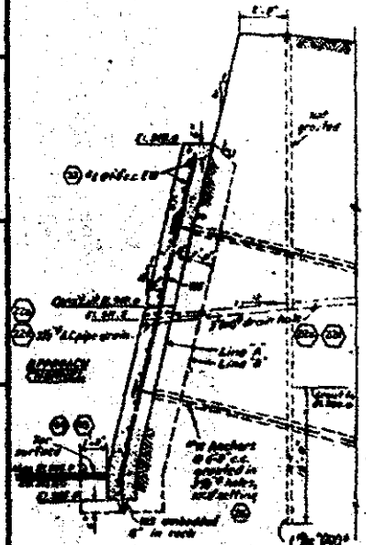

SECTION A-A
SPILLWAY
WEIR
PLAN
CONCRETE WEIR SECTION B-B
APPROACH CHANNEL
DISCHARGE CHANNEL
AUXILIARY SPILLWAY
NOTES
MOUNTAINSIDE RIVER FLOOD CONTROL
HALL MEADOW BROOK DAM
REUBEN HART DIVERSION
CONCRETE DETAILS NO. 1
HALL MEADOW BROOK CONNECTICUT



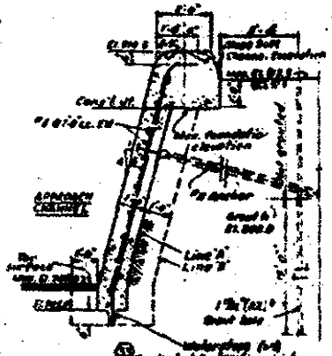
DEVELOPED ELEVATION—SOUTH WALL and AUXILIARY SPILLWAY
SCALE 1/8"=1'-0"



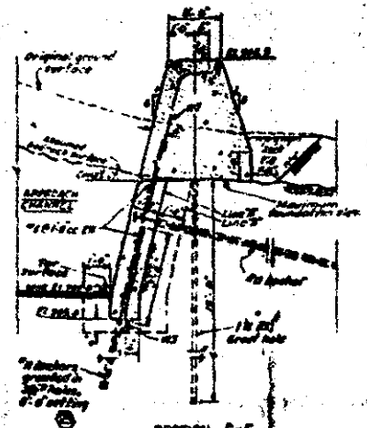
SECTION F-F
NO SCALE



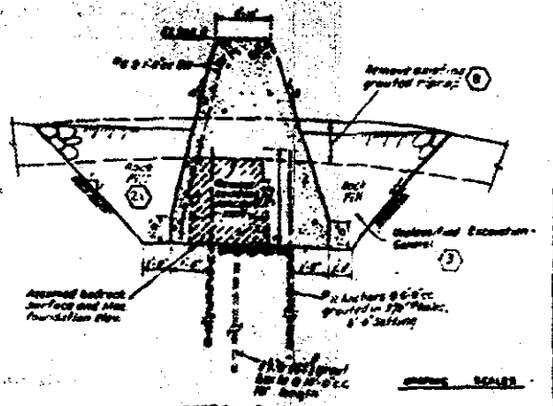
SECTION A-A



SECTION B-B



SECTION C-C



SECTION D-D

TYPICAL SECTIONS
SCALE 1/2"=1'-0"

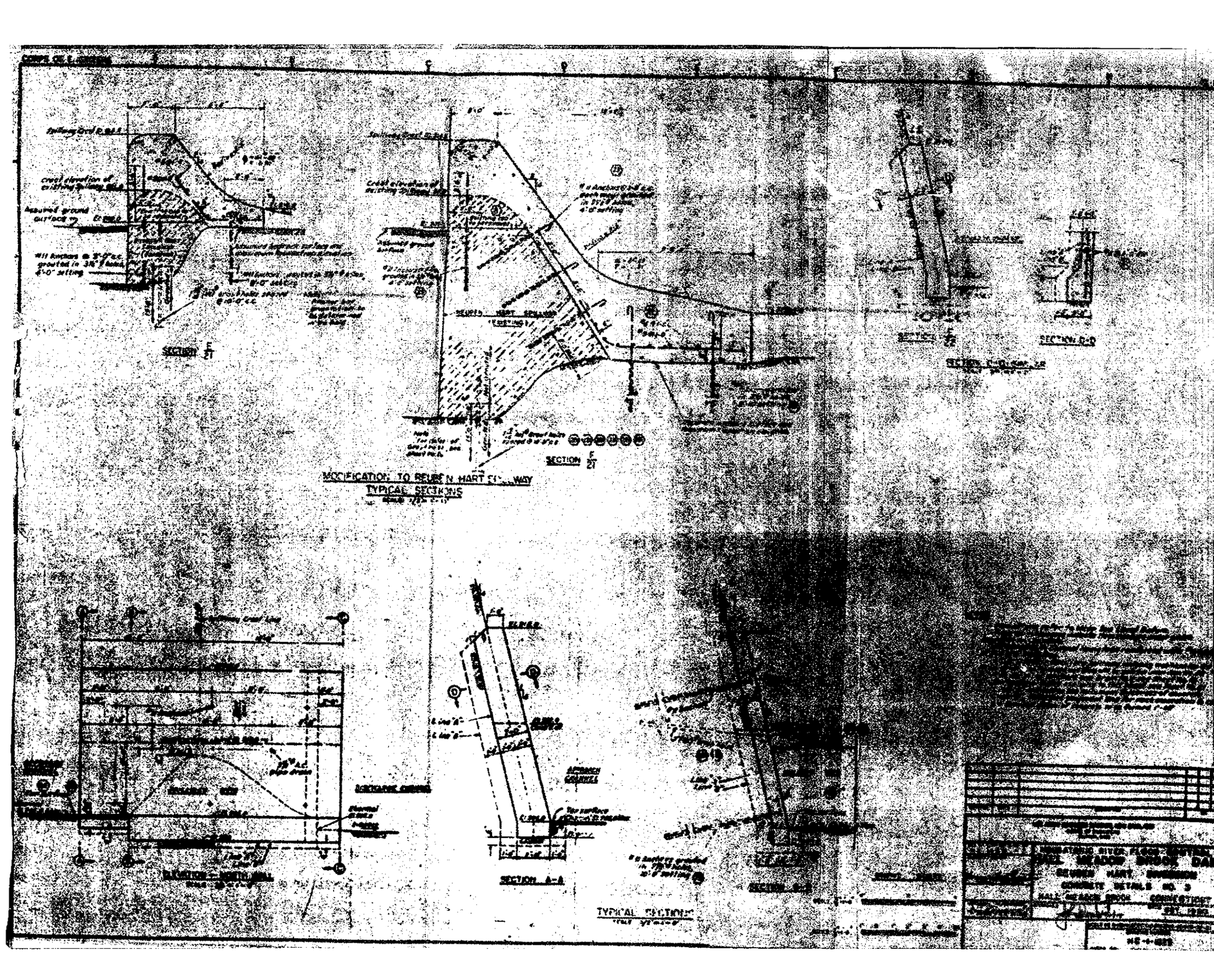
NOTES

1. Elevations refer to Mean Sea Level Datum.
2. All exposed edges of concrete to be formed 1'-0" or as shown.
3. All concrete in Channel lining to be reinforced w/ #5 bars @ 12" c.c. each way. Reinforcing steel shall not run thru contraction joints.
4. Figures in parentheses indicate item numbers under which payment will be made.
5. For additional notes applying to this sheet see Sheet No. 21
   Line "A" indicates minimum thickness of concrete.
   Line "B" indicates payment line for rock excavation and concrete.
6. All concrete in Auxiliary Spillway and Wall Lining will be paid for under Item No. 19
7. For details of Anchors and Drain holes see Sheet No. 18
8. For grouting plan and details, see sheet No. 26

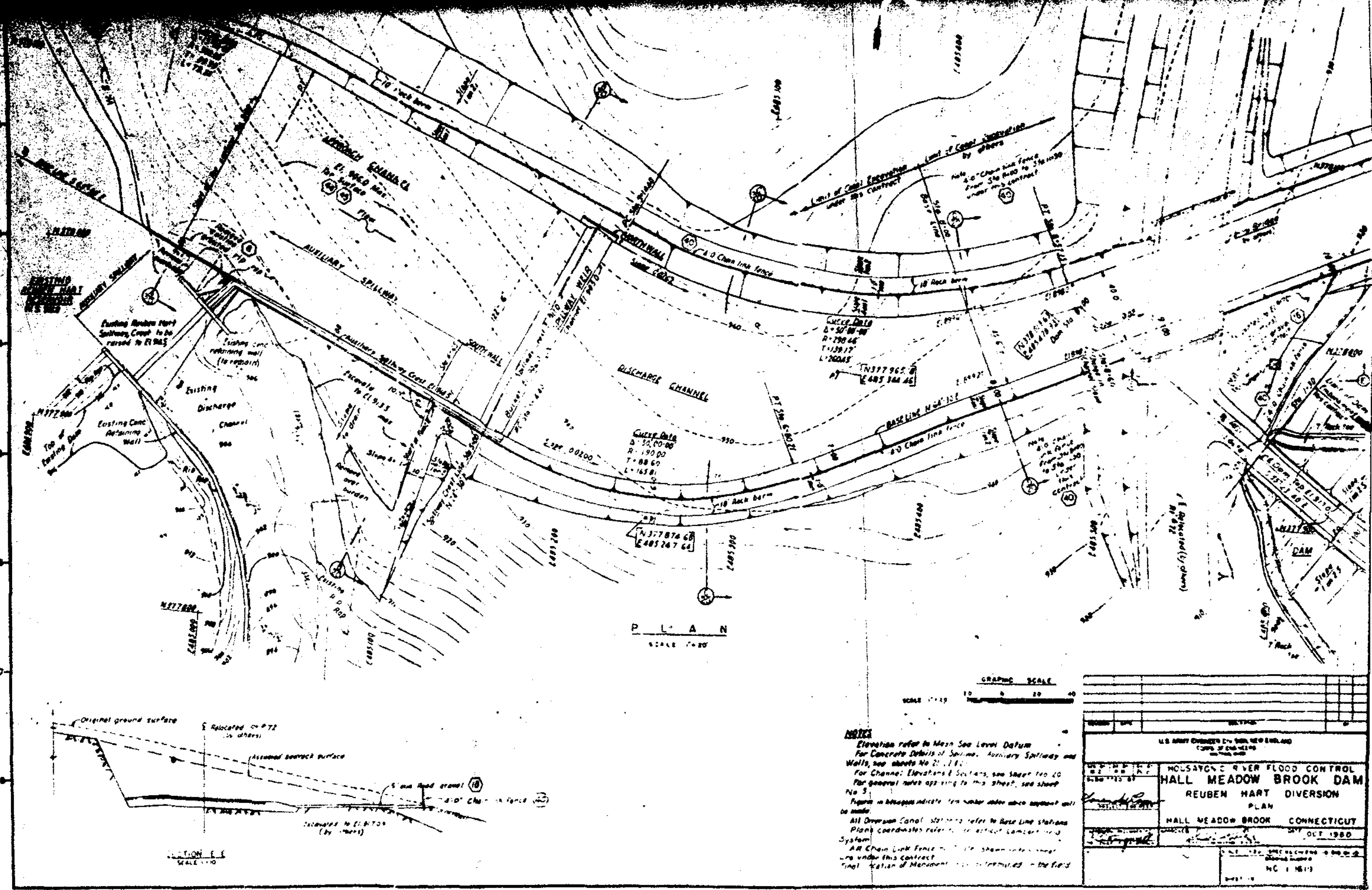
U. S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

HOUSATONIC RIVER FLOOD CONTROL
HALL MEADOW BROOK DAM
REUBEN HART DIVERSION
CONCRETE DETAILS NO 2
HALL MEADOW BROOK CONNECTICUT
OCT 1960

NC-1-1622

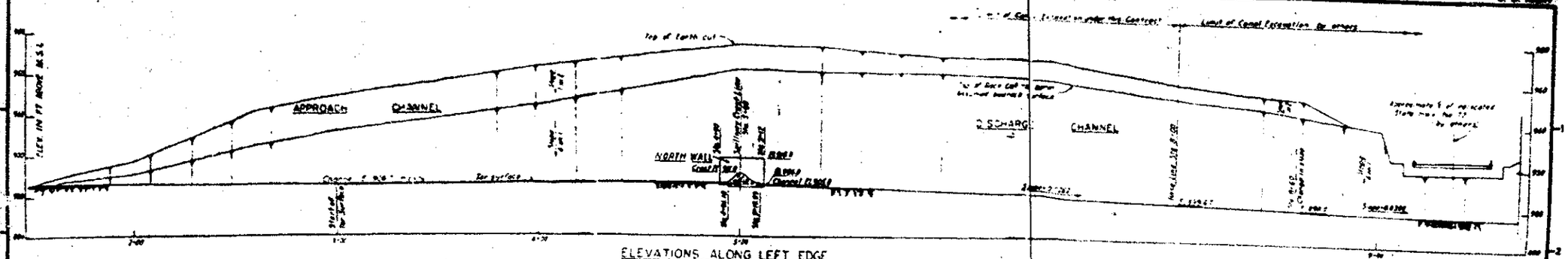


MODIFICATION TO REUBEN HART STADIUM WAY
TYPICAL SECTIONS

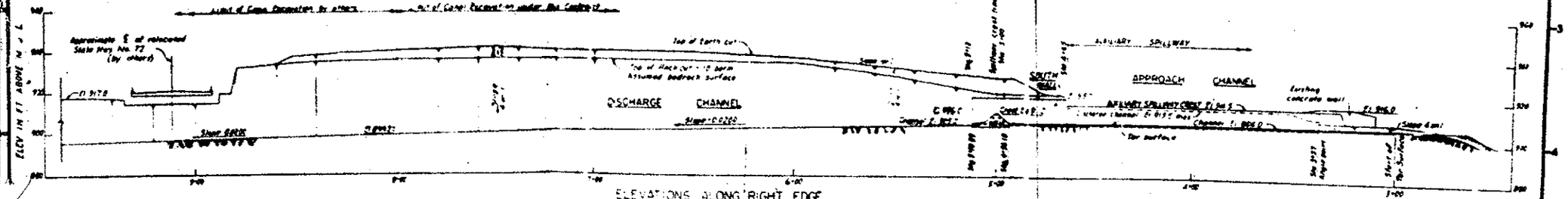


APPROACH CHANNEL
AUXILIARY SPILLWAY
DISCHARGE CHANNEL
SOUTH WALL
NORTH WALL
Existing Discharge Channel
Curve Data
BASELINE
10' Rock berm
4'-0" Chain link fence
DAM
PLAN
GRAPHIC SCALE
SECTION E-E
Original ground surface
Assumed bedrock surface
NOTES
Elevation refer to Mean Sea Level Datum
For Concrete Details of Spillway, Auxiliary Spillway and Walls, see sheets No 21, 22
For Channel Elevations & Sections, see Sheet No 20
For general notes applying to this sheet, see sheet No 3
All Diversion Canal stations refer to Base Line stations
System
are under this contract
U.S. ARMY ENGINEER DIV. NEW ENGLAND
CORPS OF ENGINEERS
HOUSATONIC RIVER FLOOD CONTROL
HALL MEADOW BROOK DAM
REUBEN HART DIVERSION
PLAN
HALL MEADOW BROOK CONNECTICUT
OCT 1960

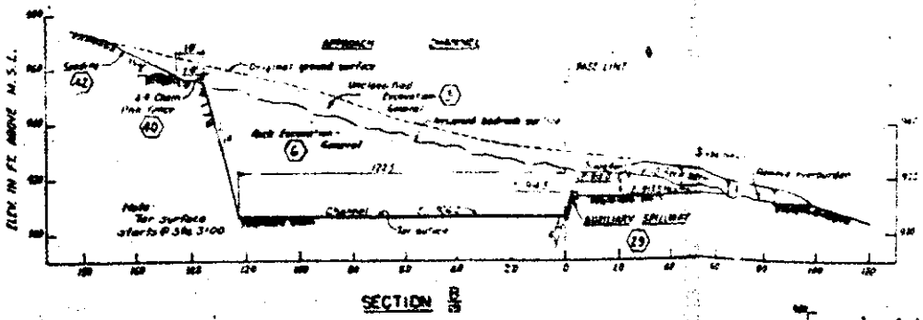
CORPS OF ENGINEERS



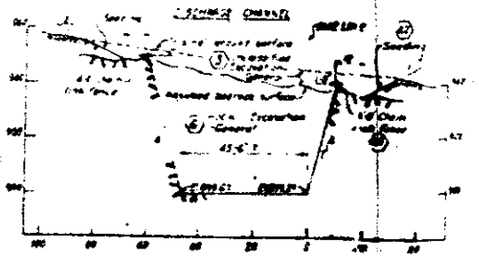
ELEVATIONS ALONG LEFT EDGE OF DIVERSION CHANNEL



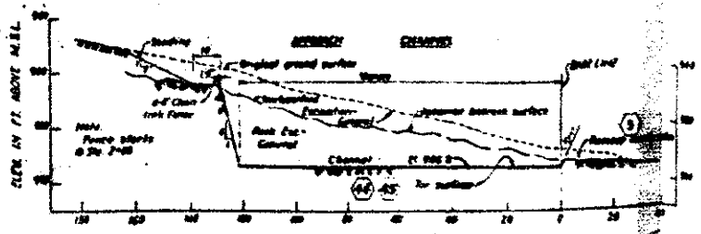
ELEVATIONS ALONG RIGHT EDGE OF DIVERSION CHANNEL



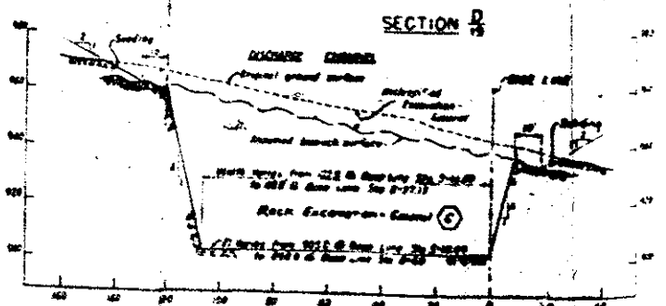
SECTION D/D



SECTION D/D



SECTION A/A



SECTION C/C

NOTES

Elevations refer to Mean Sea Level Datum

Figures in parenthesis indicate item numbers under which payment will be made

For general notes relating to this sheet, see sheet No. 19

At Diversion Channel Stationing refer to Base Line Stations

U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS

HOUSATONIC RIVER FLOOD CONTROL
HALL MEADOW BROOK DAM
REUBEN HART DIVERSION
ELEVATIONS AND SECTIONS
HALL MEADOW BROOK CONNECTICUT
DATE OCT 1960

NO. 1820

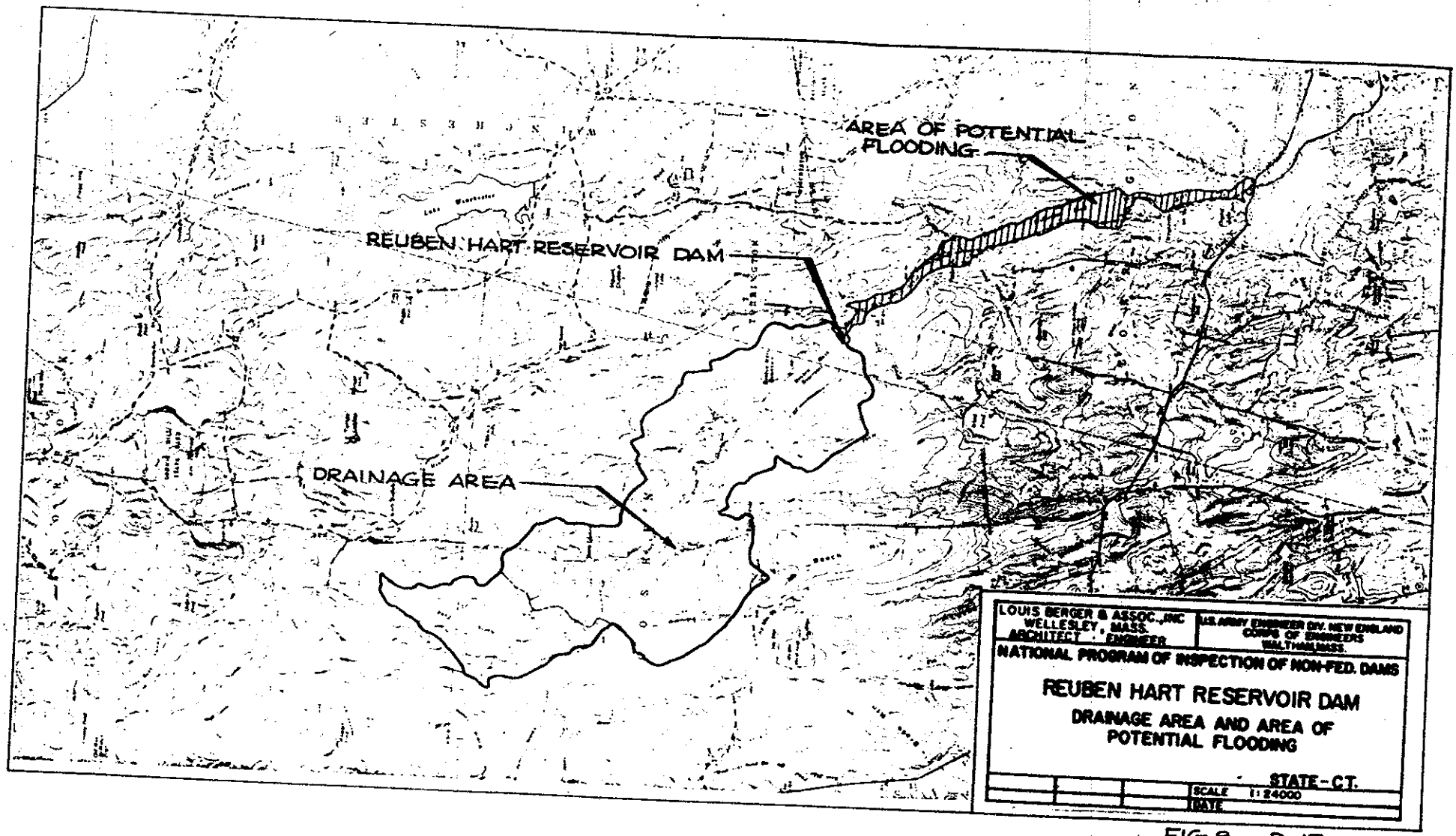
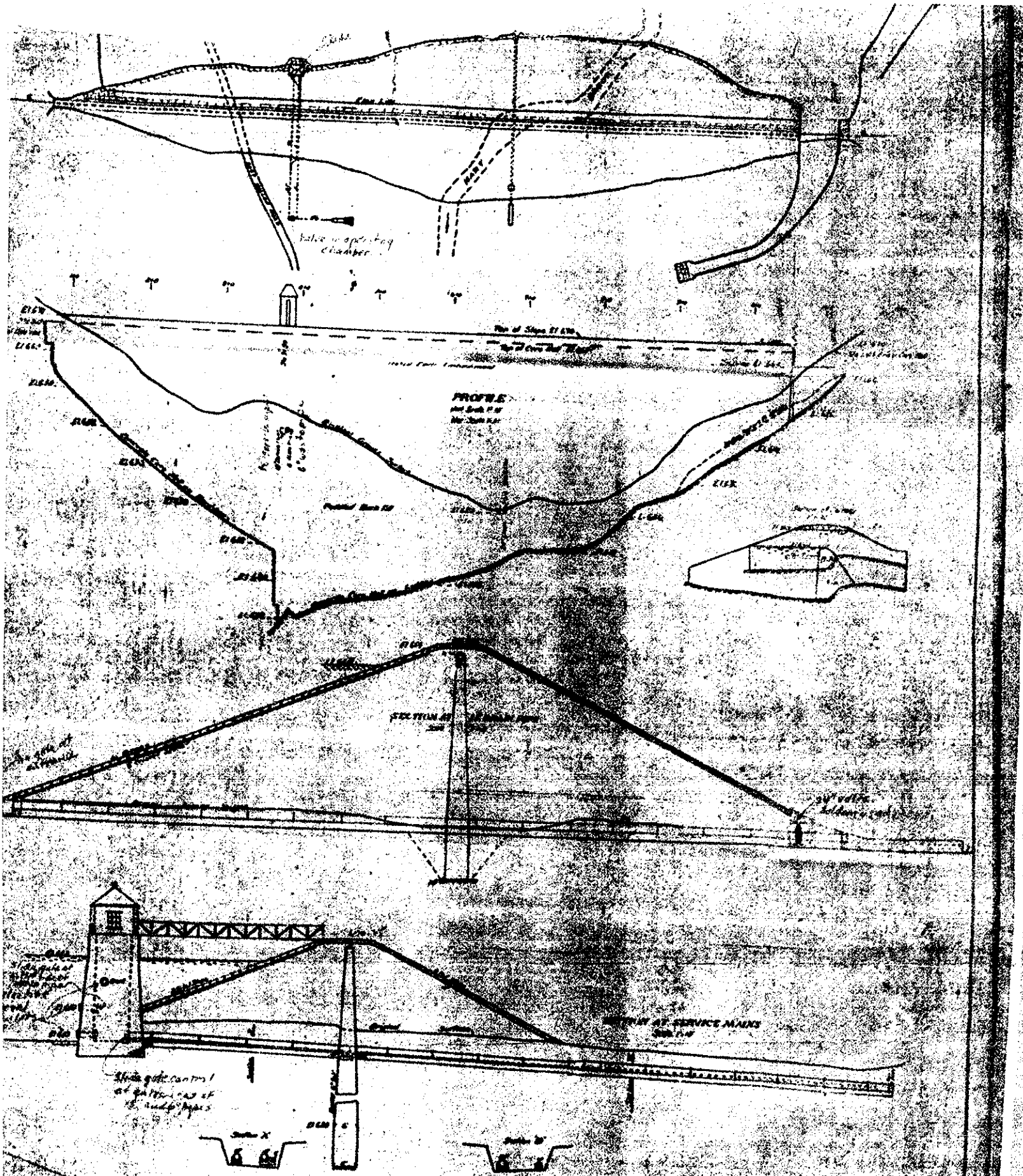

AREA OF POTENTIAL FLOODING
REUBEN HART RESERVOIR DAM
DRAINAGE AREA
LOUIS BERGER & ASSOC., INC
WELLESLEY, MASS.
ARCHITECT ENGINEER
U.S. ARMY ENGINEER DIV. NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS
REUBEN HART RESERVOIR DAM
DRAINAGE AREA AND AREA OF POTENTIAL FLOODING
STATE - CT.
SCALE 1:24000
DATE

FIG. 8 - D-17



REUBEN HART DAM

PROPERTY OF

THE TORRINGTON WATER COMPANY

I Hereby Certify, that The REUBEN HART DAM has been constructed as shown on these Plans and as approved by me

Chief Engineer
Connecticut State Board of Civil Engineers
Third District

— CERTIFICATE —

I hereby certify, that this plan represents the dam as constructed to the best of my knowledge and belief